SHUL'MAN, A., kandidat ekonomicheskikh nauk

Implement the further growth of centralized transport in the R.S.F.S.R.
Avt.transp.33 no.8:12-14 Ag'55. (MLRA 8:12)
(Transportation, Automotive)

SHUL'MAN, A., kandidat ekonomicheskikh nauk.

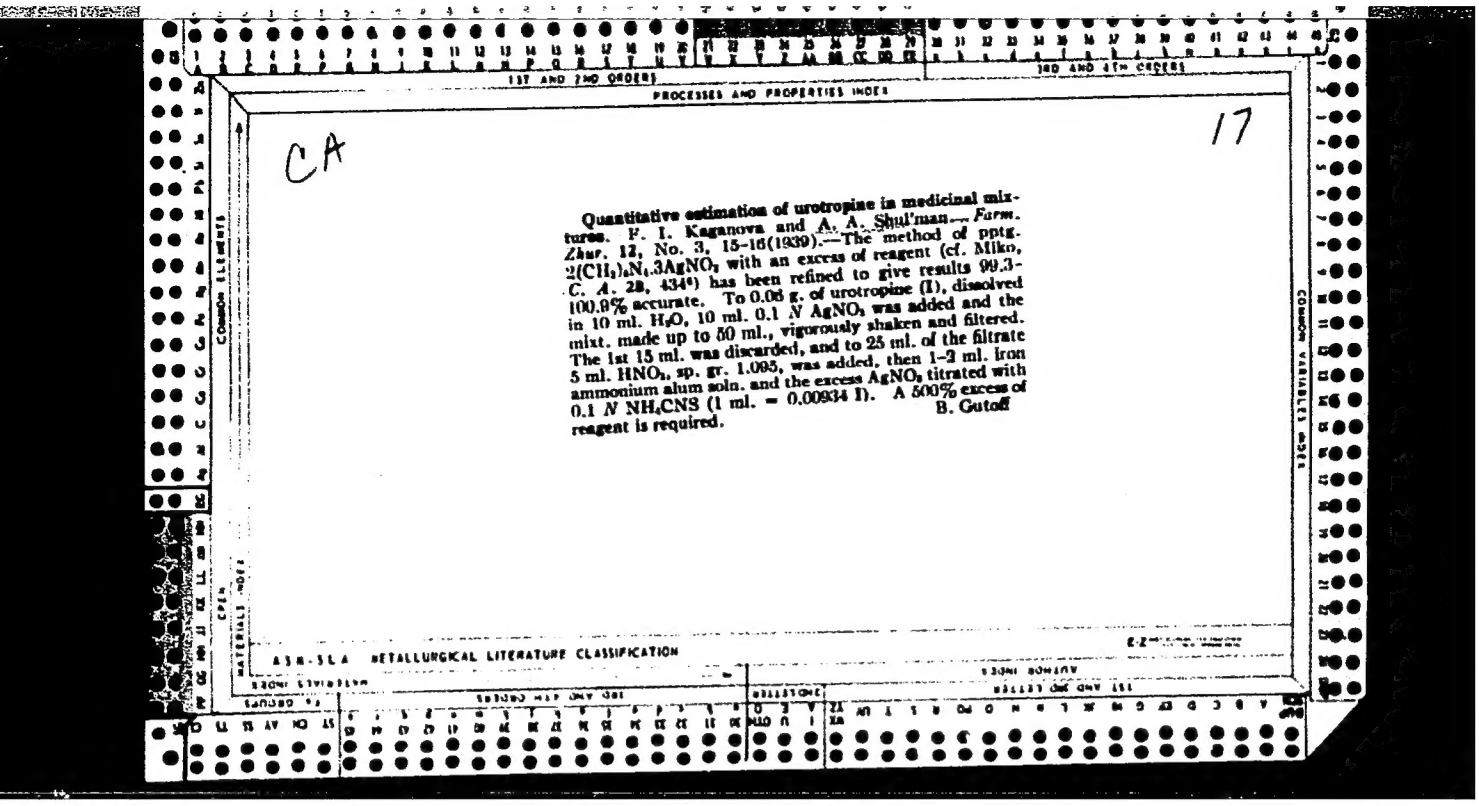
Some problems in developing production in automotive repair work.
Avt.transp.32 no.2:8-10 F '56. (MLRA 9:7)
(Automobiles--Repairing)

SHUL'MAN, A., kand. tekhn. nauk

Pay greater attention to the economic aspects of the plan.
Avt. transp. 37 no.10:40-44 O '59. (MIRA 13:2)
(Transportation, Automotive)

SHUL'MAN, A.

Increase the labor productivity. Avt.transp. 40 no.5:35-37 My '62. (MIRA 15:5)
(Transportation, Automotive--Labor productivity)



CA

17

Quantitative estimation of urotropine in medicinal mixtures. F. I. Kaganova and A. A. Shul'man.—*Farm. Zhur.* 12, No. 3, 15–16(1939).—The method of pptg. $2(CH_2)_6N_4.3AgNO_3$ with an excess of reagent (cf. Miko, *C. A.* 28, 4349) has been refined to give results 99.3–100.8% accurate. To 0.05 g. of urotropine (I), dissolved in 10 ml. H_2O, 10 ml. 0.1 *N* $AgNO_3$ was added and the mixt. made up to 50 ml., vigorously shaken and filtered. The 1st 15 ml. was discarded, and to 25 ml. of the filtrate 5 ml. HNO_3, sp. gr. 1.095, was added, then 1–2 ml. iron ammonium alum soln. and the excess $AgNO_3$ titrated with 0.1 *N* NH_4CNS (1 ml. = 0.00934 I). A 500% excess of reagent is required.

B. Gutoff

[illegible], A. A.

Shul'man, A. A. O Proiskhozhdenii I Oformlenii Vrashchatel'nykh Retsepsiy. Trudy Lab. Zool., [illegible]. No. 6, STB. 531-32

SO: Letopis' Zhurnal Statey, No. 30, Moscow, 1948

BASHTAN, F.A.; GOLOBIN, D.I.; STAPANOVA; SHUL'MAN, A.A.

Prevention of Basedow's disease caused by iodine. Vrach.delo no.2:201 F '57. (MLRA 10:6)

1. Chernovitskiy meditsinskiy institut.
(POTASSIUM IODIDE--TOXICOLOGY)
(GRAVES' DISEASES)

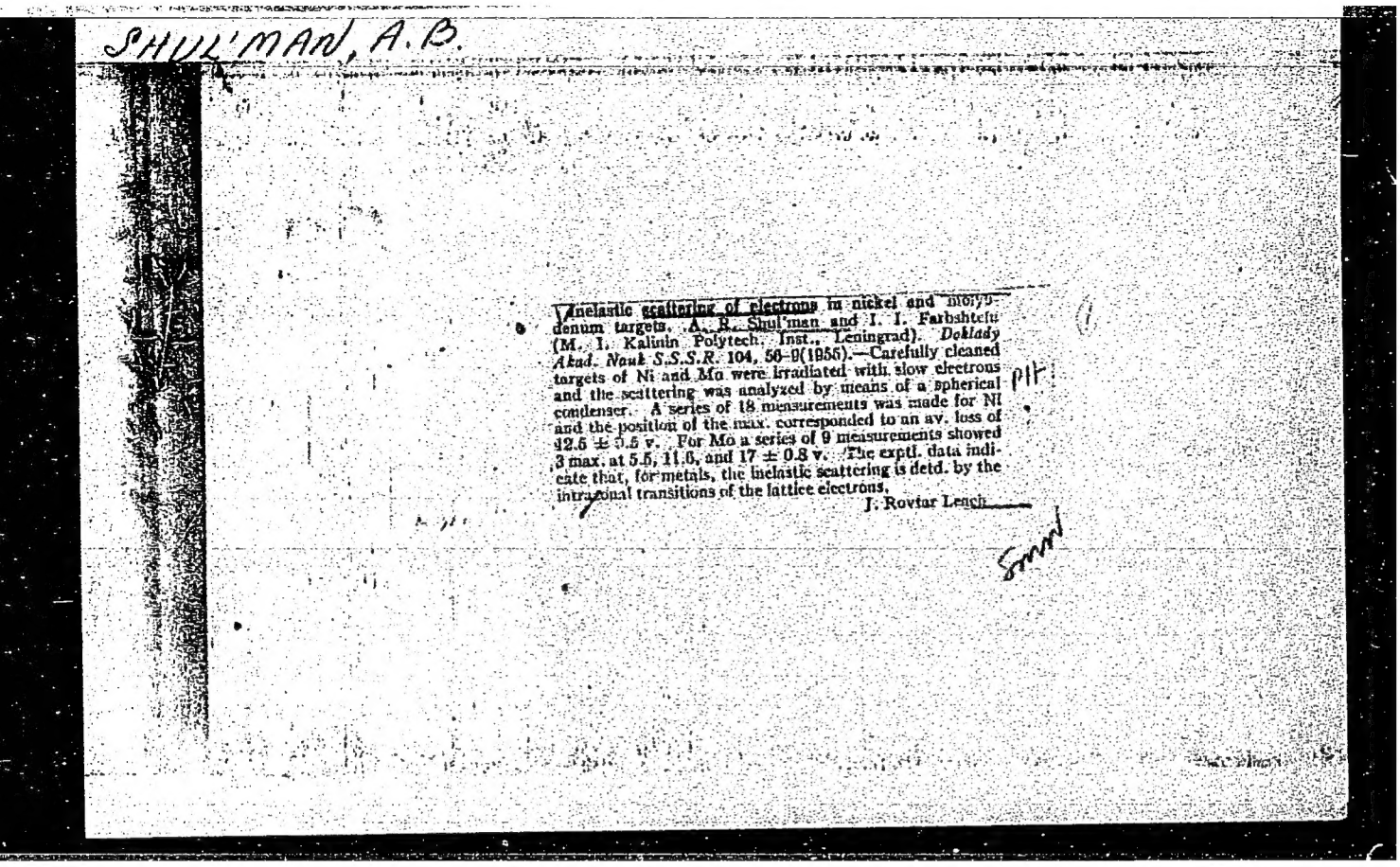
SHUL'MAN, A.A. (Chernovitsy USSR)

Preparation of Nassler reagent. Apt.delo 6 no.6:53 N-D '57. (MIRA 10:12)
(CHEMICAL TESTS AND REAGENTS)

SHUL'MAN, A.A.; ZAKRIVIDOROGA, Z.S.

Oil from linden seeds. Vrach.delo no.1:93 Ja '58. (MIRA 11:3)

1. Kafedra farmakologii (zav.-prof. S.P.Zakrividoroga) Chernovitskogo meditsinskogo instituta.
(LINDEN OIL)



SHUL'MAN, A.B.

Inelastic scattering of electrons in nickel and molybdenum targets. A. B. Shul'man and I. I. Farbshtein (M. I. Kalinin Polytech. Inst., Leningrad). *Doklady Akad. Nauk S.S.S.R.* 104, 56–9(1955).—Carefully cleaned targets of Ni and Mo were irradiated with slow electrons and the scattering was analyzed by means of a spherical condenser. A series of 18 measurements was made for Ni and the position of the max. corresponded to an av. loss of 22.5 ± 0.5 v. For Mo a series of 9 measurements showed 3 max. at 5.5, 11.6, and 17 ± 0.8 v. The exptl. data indicate that, for metals, the inelastic scattering is detd. by the intraatomic transitions of the lattice electrons.

J. Rovtar Lench

Smm

AUTHOR: Shul'man, A. B. SOV/57-56-8-16/37

TITLE: Work Function of Thin Films of Thorium Oxide and of Thorium on Tungsten (Rabota vykhoda tonkikh plenok okisi toriya i toriya na vol'frame)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Nr 8, pp 1711 - 1713 (USSR)

ABSTRACT: This is a study of the behaviour of thin thorium oxide films on tungsten, which is of importance in practical work. The experiments were carried out according to the method described in reference 1 and with the same equipment. The application of the film, the activation of the films and the measurement of their thickness was carried out similarly as in reference 1. The measurements were made by the student-diplomantka (preparing for her diploma)V.P.Klychkova. New, not activated, oxidized and activated films were examined. The activation temperature of the various cathodes was within the range of 1300 - 1650°K. The activation period usually was about 1 hour. A stable emission was obtained after 30-40 minutes. The measured values of the work function of tungsten

Card 1/3

filaments well agree with data presented in publications. The process of cathode activation and hence also the activation curves are similar to those of films on a molybdenum basis. However, the desoxidation of thorium oxide on tungsten proceeds less easily than that on a molybdenum basis. The principal results are interpreted in a similar manner as were those in reference 1. The mean results of these and of earlier measurements are compared. It is shown that in a steady state the general course taken by the functions $\varphi=\varphi(\theta)$ and $A = A(\theta)$ almost coincides for films on tungsten and on molybdenum. When films on tungsten are exposed to air for a certain time, a comparatively high work function was observed in a few cases (at small θ) up to 6 eV. This was not observed on a molybdenum basis. The information obtained indicates that thin films of thorium oxide on tungsten are completely desoxidized to metallic thorium, whereas in thicker layers the oxide is only partially reduced. There are 2 figures, 1 table, and 1 reference, 1 of which is Soviet.

Work Function of Thin Films of Thorium Oxide and of Thorium on Tungsten SOV/57-58-8-16/37

ASSOCIATION: Leningradskiy politekhnicheskiy institut im.M.I.Kalinina (Leningrad Polytechnical Institute imeni M.I.Kalinin)

SUBMITTED: September 18, 1957

Card 3/3

CHISTYAKOV, A.N., GONOR, A.A., SHUL'MAN, A.I.

Some data on the chemical composition of pitch distillates.
Trudy LTI no.58:71-74 '59. (MIRA 13:7)

1. Leningradskiy tekhnologicheskiy institut im. Lensoveta.
(Coal-tar products)

SHUL'MAN, A.M.

Neglected field of work. Apt.delo 3 no.1:30-31 Ja-F '54.
(MLRA 7:1)

1. Zaveduyushchiy otdelom aptechnoy seti Chernovitskogo oblastnogo aptechnogo upravleniya. (Mgr., Div. of Pharmacies, Chernovtsy Obl. Pharmacology Admin./Ukr.SSR Min.Heal
(Ukraine--Pharmacy) (Pharmacy--Ukraine)

SHUL'MAN, A.M.

Speed up the medicinal service for workers. Farmatsev. zhur. 17 no.3: 70-71 '62. (MIRA 17:10)

1. Aptechnoye upravleniye Chernovitskogo oblastnogo otdela zdravookraneniya.

SHUL'MAN, A.M.

Pharmacy in Bukovina. Apt. delo 3 no.4:42-43 Jl-Ag '54. (MLRA 7:8)
(PHARMACY,
*in Russia)

SHUL'MAN, A.N.; DEMENT'YEV, B.P.

Secondary electron emission of alkali halide single crystals. (MLRA 9:2)
Zhur.tekh.fiz. 25 no.13:2256-2263 N '55.
(Alkali metal salts) (Electrons)

SHUL'MAN, A. R.

"Problem of Calculating the Lifting Capacity of Ice Cover," Works of Sci-Res Institution of the Main Administration of the Hydrometeorological Service USSR, Series V, No 20, 1946 (9-15).
(Meteorologiya i Gidrologiya, No 6 Nov/Dec 1947)

SO: U-3218, 3 Apr 1953

SHUL'MAN, A. R.

"Calculation of the Lifting Capacity of Ice Crossings According to the Theory of Center Flexure of an Elastic Plate on an Elastic Base," Works of Sci-Res Institution of the Main Administration of the Hydrometeorological Service USSR, Series V, No 20, 1946 (30-38). (Meteorologiya i Gidrologiya, No 6 Nov/Dec 1947)

SO: U-3218, 3 Apr 1953

SHUL'MAN, A. R.

LAGUTIN, B. L. and SHUL'MAN, A. R., "Methods for Calculating the Ice Crossings," Works of Sci-Res Institution of the Main Administration of the Hydrometeorological Service USSR, Series V, No 20, 1946 (39-49).
(Meteorologiya i Gidrologiya, No 6 Nov/Dec 1947)

SO: U-3218, 3 Apr 1953

SHUL'MAN, A. R.

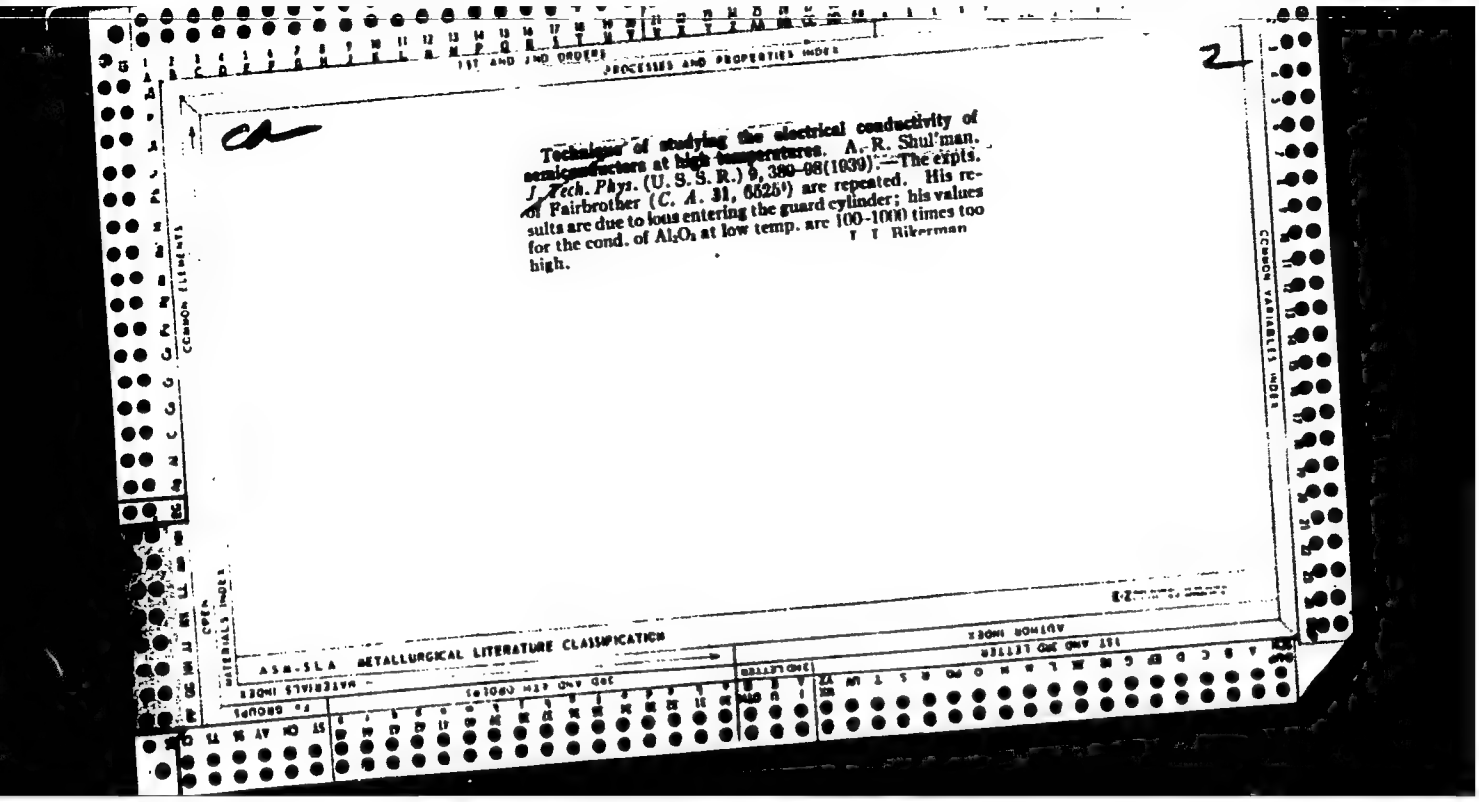
"Theoretical and Experimental Basis of Tables for Load Capacity of Ice Cover," Works of Sci-Res Institution of the Main Administration of the Hydrometeorological Service USSR, Series V, No 20, 1946 (56-86).
(Meteorologiya i Gidrologiya, No 6 Nov/Dec 1947)

SO: U-3218, 3 Apr 1953

SHUL'MAN, A. R.

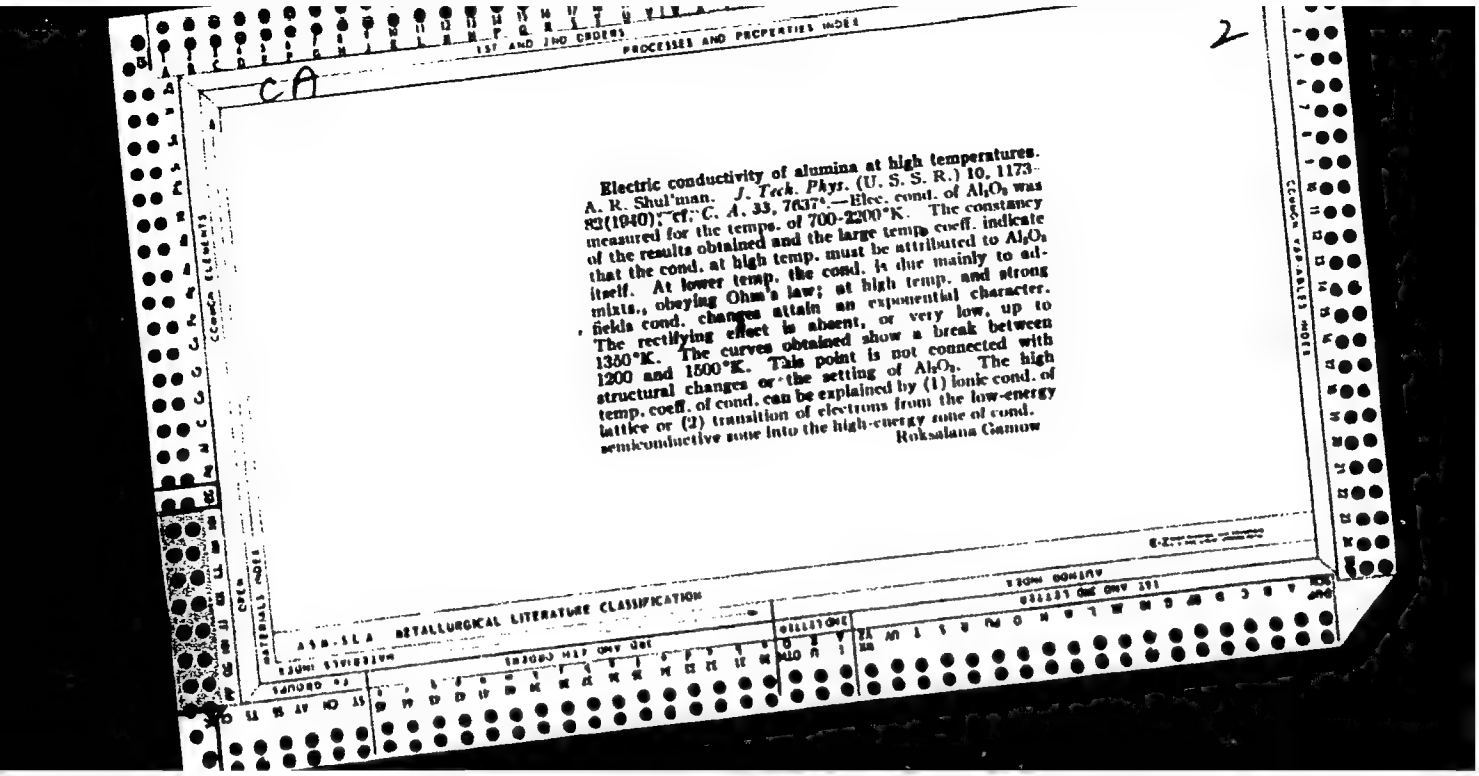
18960 Nachal'nye Stadii Deformatsii L'da. Trydy Gos. Gidrol, In-Ta, Vyp. 16, 1949, S. 101-03

SO: Letopis' Zhurnal'nykh Statey, Vol. 39, Moskva, 1949



Techniques of studying the electrical conductivity of semiconductors at high temperatures. A. R. Shul'man. *J. Tech. Phys.* (U. S. S. R.) 9, 389–98(1939).—The expts. of Fairbrother (*C. A.* 31, 6625[9]) are repeated. His results are due to ions entering the guard cylinder; his values for the cond. of Al_2O_3 at low temp. are 100–1000 times too high.

T. T. Bikerman

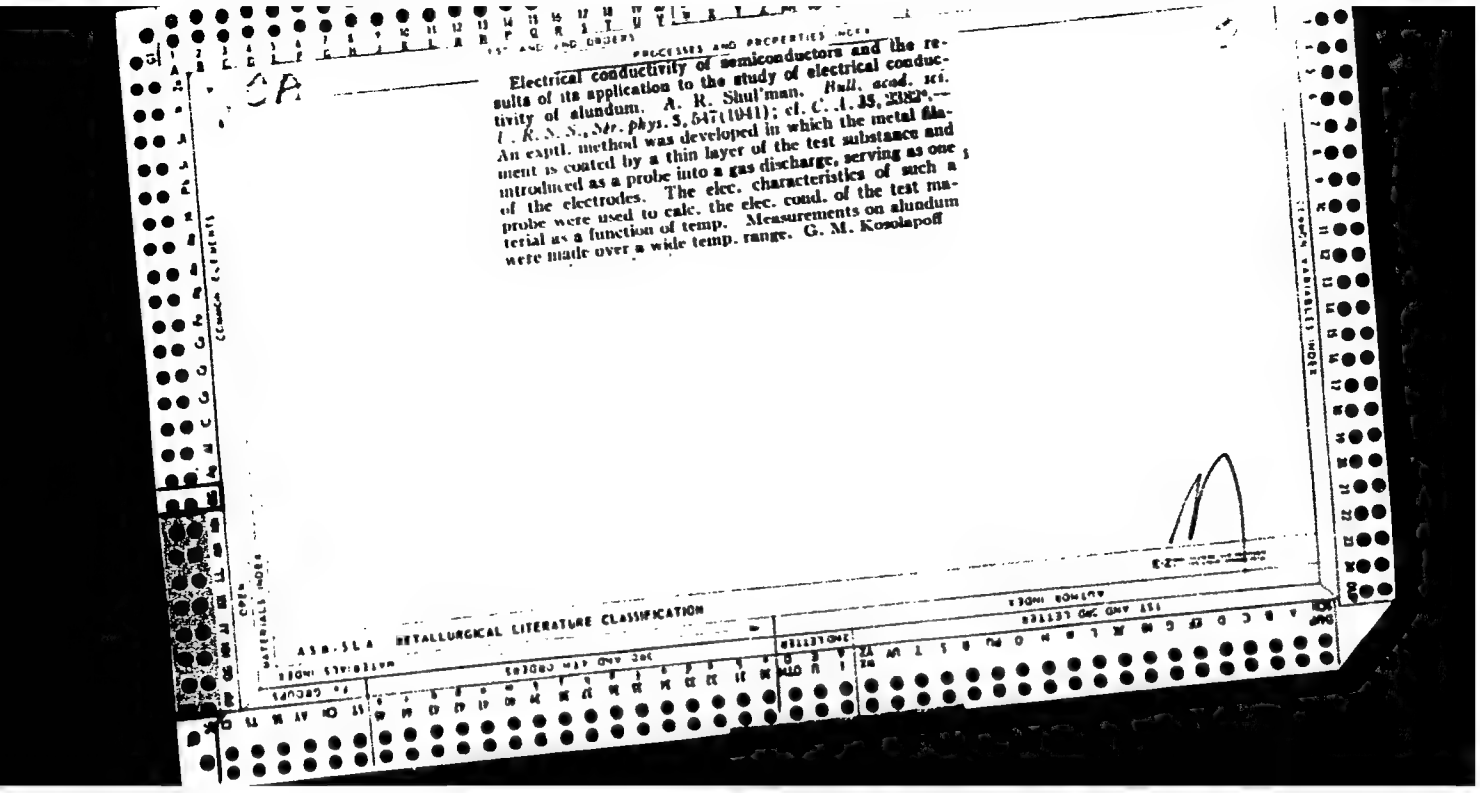


CA

2

Electric conductivity of alumina at high temperatures. A. R. Shul'man. *J. Tech. Phys.* (U. S. S. R.) 10, 1173-83(1940); cf. *C. A.* 33, 7637°.—Elec. cond. of Al_2O_3 was measured for the tempo. of 700-2200°K. The constancy of the results obtained and the large temp. coeff. indicate that the cond. at high temp. must be attributed to Al_2O_3 itself. At lower temp. the cond. is due mainly to admixts., obeying Ohm's law; at high temp. and strong fields cond. changes attain an exponential character. The rectifying effect is absent, or very low, up to 1380°K. The curves obtained show a break between 1200 and 1500°K. This point is not connected with structural changes or the setting of Al_2O_3. The high temp. coeff. of cond. can be explained by (1) ionic cond. of lattice or (2) transition of electrons from the low-energy semiconductive zone into the high-energy zone of cond.

Roksalana Gamow



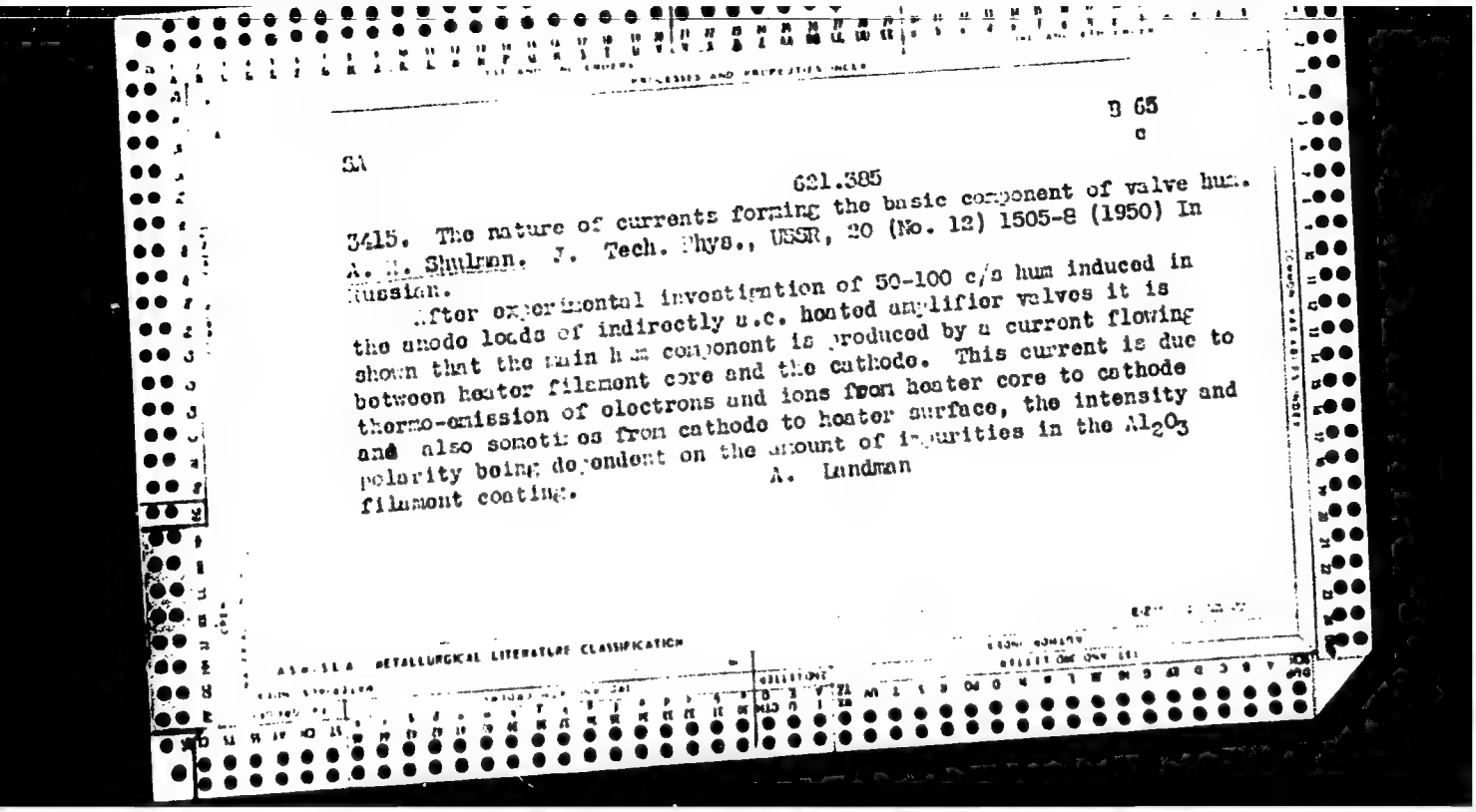
Electrical conductivity of semiconductors and the results of its application to the study of electrical conductivity of alundum. A. R. Shul'man. *Bull. acad. sci. U. R. S. S., Sér. phys.* 5, 547(1941); cf. *C. A.* 35, 2382⁹.—An exptl. method was developed in which the metal filament is coated by a thin layer of the test substance and introduced as a probe into a gas discharge, serving as one of the electrodes. The elec. characteristics of such a probe were used to calc. the elec. cond. of the test material as a function of temp. Measurements on alundum were made over a wide temp. range. G. M. Kosolapoff

SHUL'MAN, A.P.

SENA, L.A.; VAVILOV, S.I., akademik, redaktor; IOFFE, A.F. akademik, redaktor; LUKIRSKIY, P.I., akademik, redaktor; FOK, V.A., akademik, redaktor; FRENKEL', Ya.I., redaktor; SHUL'MAN, A.P., redaktor; VOLCHOK, K.M., tekhnicheskiy redaktor.

Collisions of electrons and ions with gas atoms] Stolknoveniia elektronov i ionov s atomami gaza. Leningrad, Gos.izd-vo tekhniko-teoret.lit-ry 1948. 215 p. [Microfilm] (MLRA 10:6)

1. Chlen-korrespondent AN SSSR (for Frenkel')
(Collisions (Nuclear physics))



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S4

621.385

3415. The nature of currents forming the basic component of valve hum. A. M. Shulman. J. Tech. Phys., USSR, 20 (No. 12) 1505-8 (1950) In Russian.

After experimental investigation of 50-100 c/s hum induced in the anode loads of indirectly h.c. heated amplifier valves it is shown that the main hum component is produced by a current flowing between heater filament core and the cathode. This current is due to thermo-emission of electrons and ions from heater core to cathode and also sometimes from cathode to heater surface, the intensity and polarity being dependent on the amount of impurities in the Al_2O_3 filament coating.

A. Landman

SHUL'MAN, A. R.

PA 174T77

USSR/Physics - Electron Emission, 21 Sep 50
Secondary

"Secondary Electron Emission of Aluminum Oxide," A. R. Shul'man, I. Yu. Rozentsveyg, Leningrad Polytech Inst imeni Kalinin

"Dok Ak Nauk SSSR" Vol LXXIV, No 3, pp 497-500

Clarifies nature of temp dependence of coeff, sigma, for dielec and semiconductors. Curves of sigma vs electron energy and temp (1,400-1,900°C); voltage drop in dielec layer vs temp for secondary and thermoelectron emissions; sigma vs time. Submitted 15 Jul 50 by Acad P. I. Lukirskiy.

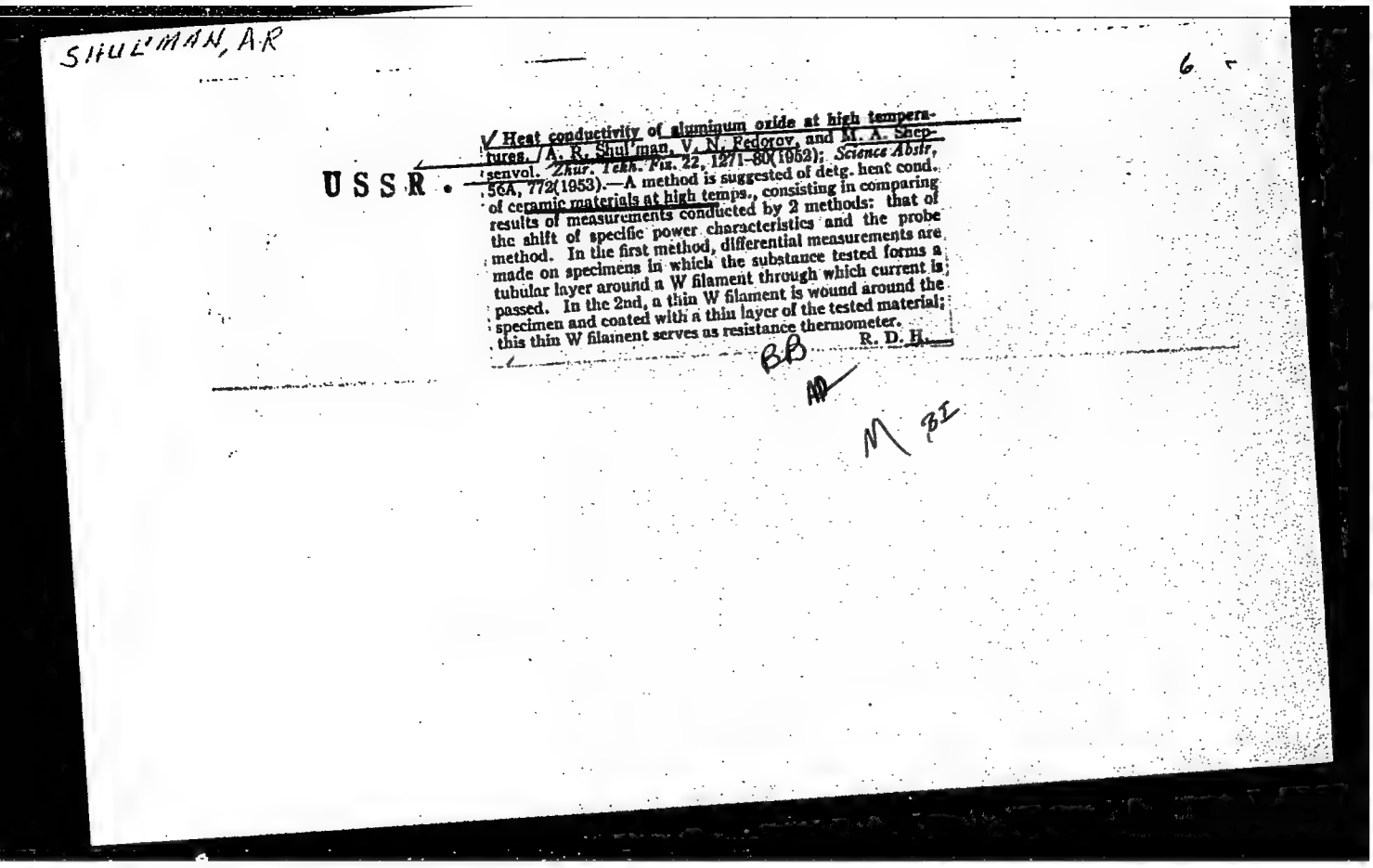
174T77

SHUL'MAN, A. R.

GTRSPL, Vol. 4, No. 8

Shul'man, A. R., Thenature of currents creating the main component of noise of radio tubes, 1505-8.

Zhurnal Tekhnicheskoi Fiziki, Vol. 20, No. 12 (1951)



SHUL'MAN, A.R

6

USSR

Heat conductivity of aluminum oxide at high temperatures. / A. R. Shul'man, V. N. Fedorov, and M. A. Shepsenvol. *Zhur. Tekh. Fiz.* 22, 1271-80(1952); *Science Abstr.*, 56A, 772(1953).—A method is suggested of detg. heat cond. of ceramic materials at high temps., consisting in comparing results of measurements conducted by 2 methods: that of the shift of specific power characteristics and the probe method. In the first method, differential measurements are made on specimens in which the substance tested forms a tubular layer around a W filament through which current is passed. In the 2nd, a thin W filament is wound around the specimen and coated with a thin layer of the tested material; this thin W filament serves as resistance thermometer.

R. D. H.

B.B

AP

M BI

SHUL'MAN, A. R.

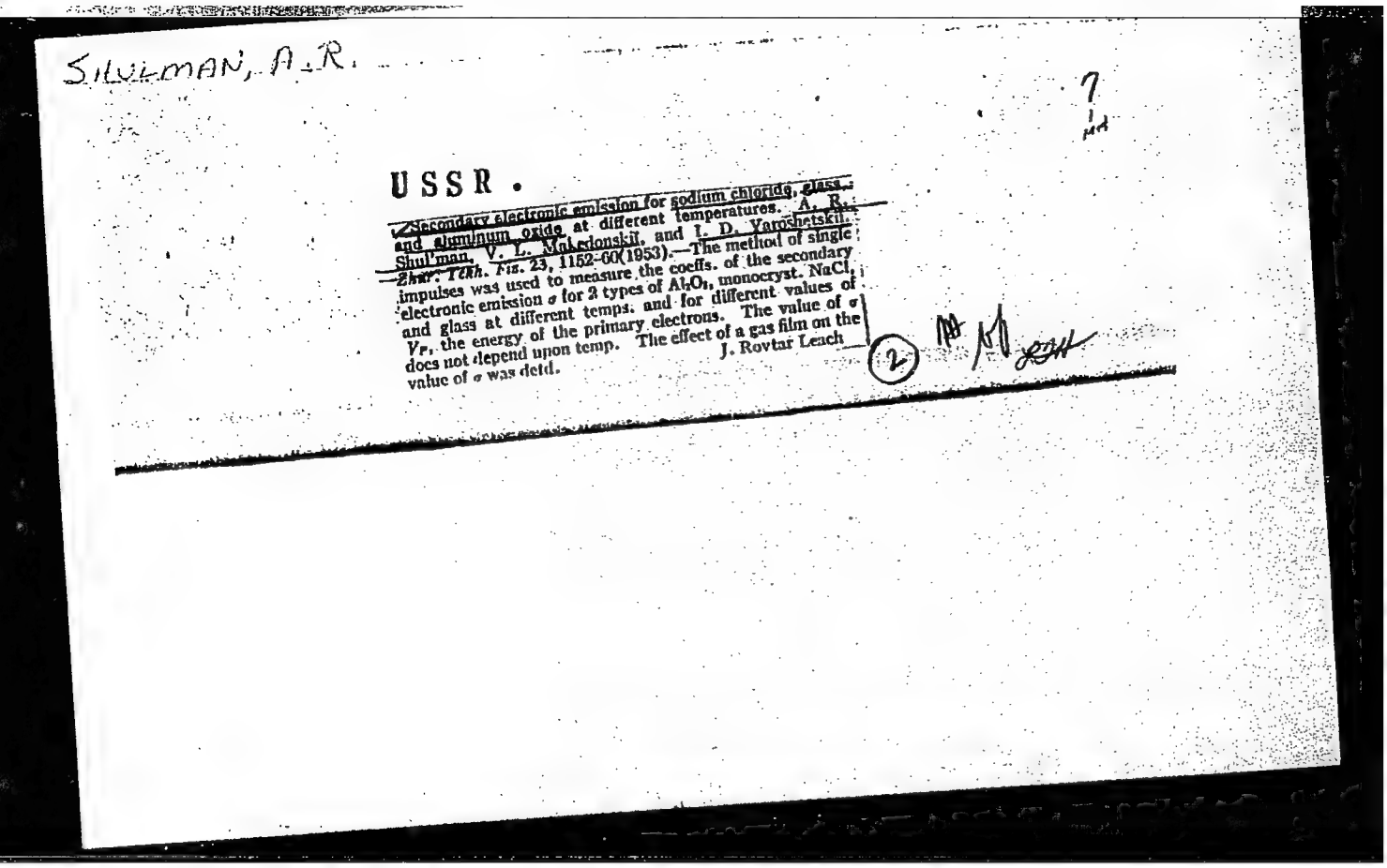
USSR/Electronics - Dielectrics, Secondary Emission — Oct 52

"Study of Secondary Electron Emission of Dielectrics in the Range of Single Pulses" A. R. Shul'man and V. L. Makedonskiy

"Zhur Tekh Fiz" Vol 22, No 10, pp 1540-1542

Coeff of secondary emission of dielectric varies with time. Writers tested coeff by 3 methods: under stationary initial current, under periodic pulses, and under single pulses. Results on tantalum target showed agreement with data obtained by Warneke. Received 25 Jun 52.

236T52



SHULMAN, A.R.

7
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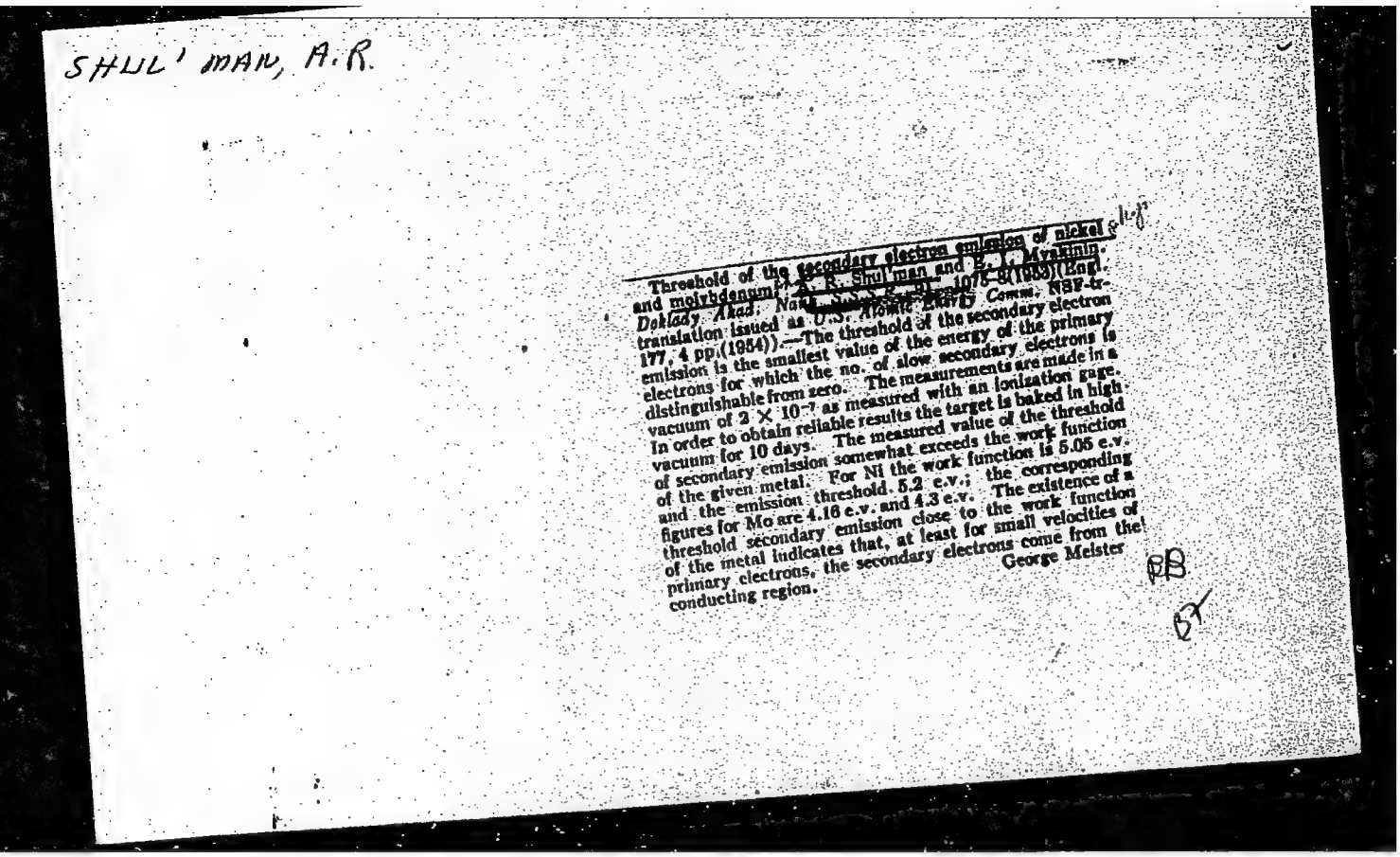
HH

USSR •

Secondary electronic emission for sodium chloride, glass, and aluminum oxide at different temperatures. A. R. Shul'man, V. L. Makedonskii, and I. D. Yaroshetskii. *Zhur. Tekh. Fiz.* 23, 1152-60(1953).—The method of single impulses was used to measure the coeffs. of the secondary electronic emission σ for 2 types of Al_2O_3, monocryst. NaCl, and glass at different temps. and for different values of V_{P_1}, the energy of the primary electrons. The value of σ does not depend upon temp. The effect of a gas film on the value of σ was detd.

J. Rovtar Leach

(2)

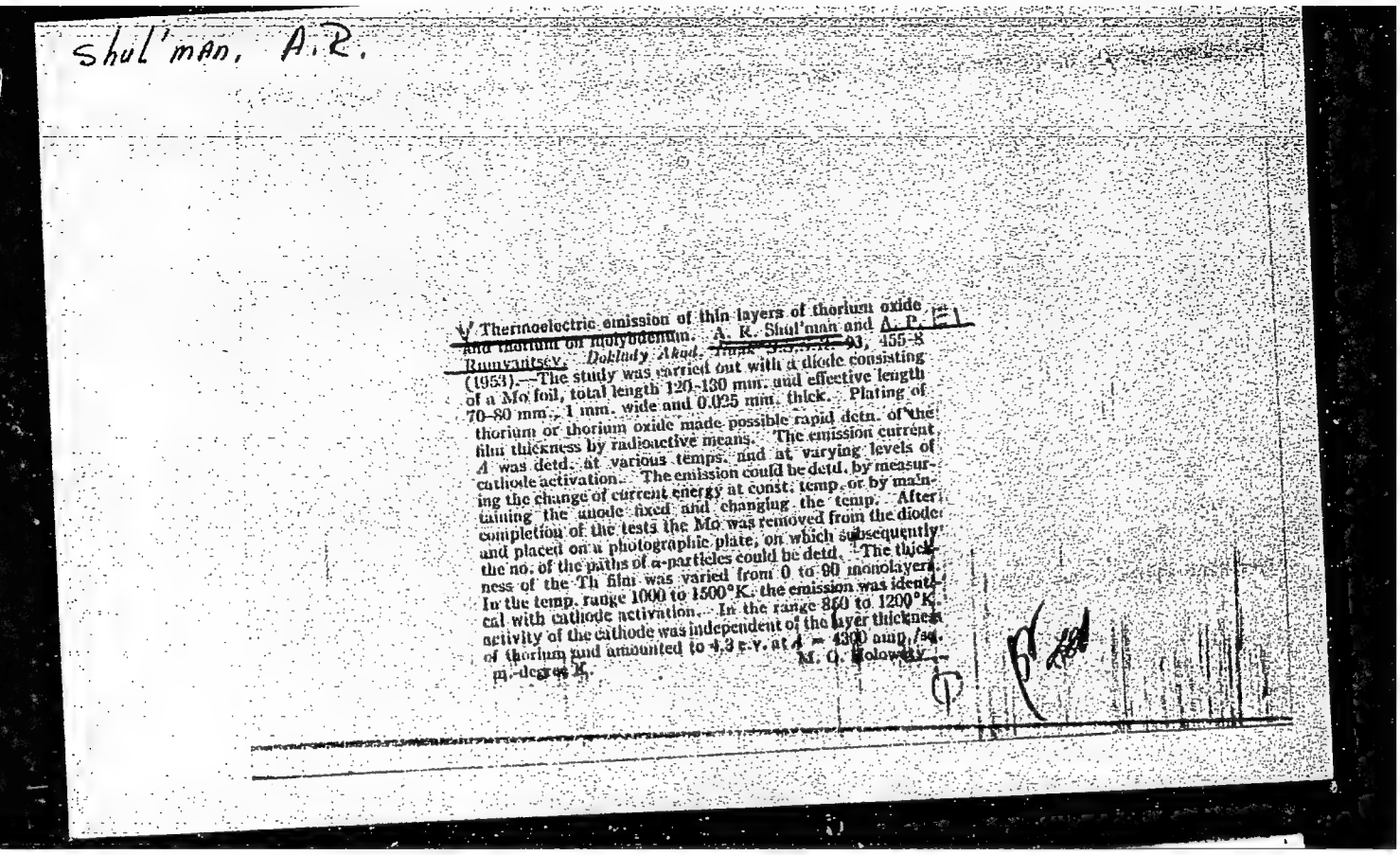


SHUL' MAN, A.R.

Threshold of the secondary electron emission of nickel and molybdenum. A. R. Shul'man and B. . Myakinin. *Doklady Akad. Nauk* [illegible] 10[illegible]8(1953)(Engl. translation issued as U.S. Atomic Energy Comm. NSF-tr-177, 4 pp.(1954)).—The threshold of the secondary electron emission is the smallest value of the energy of the primary electrons for which the no. of slow secondary electrons is distinguishable from zero. The measurements are made in a vacuum of 2×10^{-7} as measured with an ionization gage. In order to obtain reliable results the target is baked in high vacuum for 10 days. The measured value of the threshold of secondary emission somewhat exceeds the work function of the given metal. For Ni the work function is 5.05 e.v. and the emission threshold 5.2 e.v.; the corresponding figures for Mo are 4.16 e.v. and 4.3 e.v. The existence of a threshold secondary emission close to the work function of the metal indicates that, at least for small velocities of primary electrons, the secondary electrons come from the conducting region.

George Meister

PB 87



Shul'man, A.R.

Thermoelectric emission of thin layers of thorium oxide and thorium on molybdenum. A. R. Shul'man and A. P. Rumyantsev. *Doklady Akad. Nauk S.S.S.R.* 93, 455-8 (1953).—The study was carried out with a diode consisting of a Mo foil, total length 120–130 mm. and effective length 70–80 mm., 1 mm. wide and 0.025 mm. thick. Plating of thorium or thorium oxide made possible rapid detn. of the film thickness by radioactive means. The emission current A was detd. at various temps. and at varying levels of cathode activation. The emission could be detd. by measuring the change of current energy at const. temp. or by maintaining the anode fixed and changing the temp. After completion of the tests the Mo was removed from the diode and placed on a photographic plate, on which subsequently the no. of the paths of α-particles could be detd. The thickness of the Th film was varied from 0 to 90 monolayers. In the temp. range 1000 to 1500°K. the emission was identical with cathode activation. In the range 860 to 1200°K. activity of the cathode was independent of the layer thickness of thorium and amounted to 4.3 e.v. at A = 4300 amp./sq. m.-degree K.

M. Q. Holowaty

FD-509

SHUL'MAN, A. R.

USSR/Electronics - Secondary emission

Card 1/1 : Pub. 153-9/28

Author : Shul'man, A. R., and Yaroshetskiy, I. D.

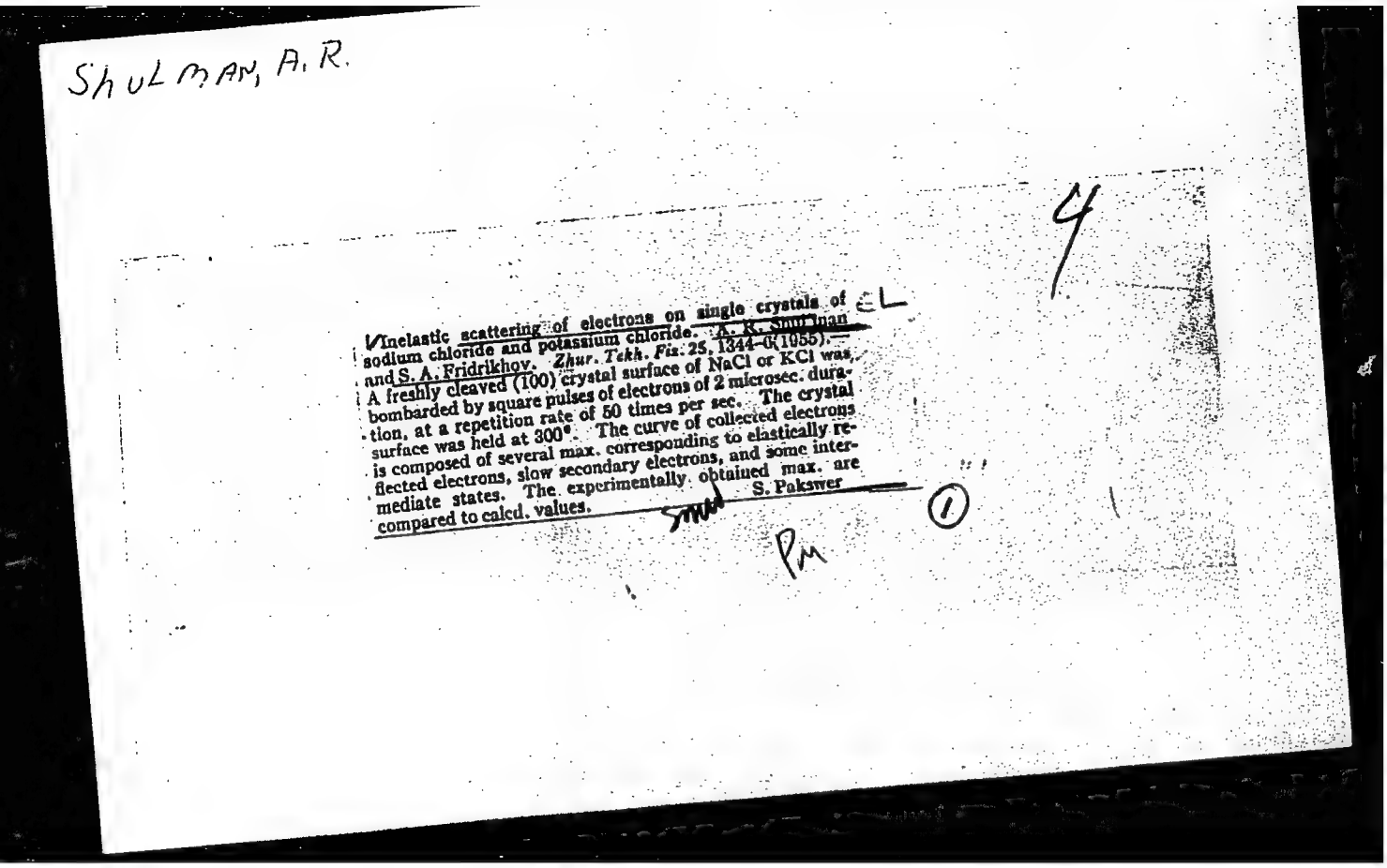
Title : Secondary electronic emission of thorium oxide

Periodical : Zhur. tekh. fiz. 24, 845-854, May 1954

Abstract : Investigates the dependence of the coefficient of secondary electronic emission upon the energy of the primary electrons and upon the temperature of the target. Concludes that the transition of theorium oxide from the inactivated state to the activiated slate is accompanied by a decrease in the coefficient of secondary emission, which fact does not substantiate the conclusion of Arizumi and Esaki (J. Phys. Soc. Jap. 6, 113, 1951). Thanks Acad. P. I. Lukirskiy, in whose laboratory the work was done.

Institution :

Submitted : December 10, 1953



SHULMAN, A. R.

4

Inelastic scattering of electrons on single crystals of sodium chloride and potassium chloride. A. R. Shul'man and S. A. Fridrikhov. *Zhur. Tekh. Fiz.* 25, 1344-9(1955).—A freshly cleaved (100) crystal surface of NaCl or KCl was bombarded by square pulses of electrons of 2 microsec. duration, at a repetition rate of 50 times per sec. The crystal surface was held at 300°. The curve of collected electrons is composed of several max. corresponding to elastically reflected electrons, slow secondary electrons, and some intermediate states. The experimentally obtained max. are compared to calcd. values. S. Paksuer

FD-3129

USSR/Physics - Semiconductors

Card 1/1 Pub 153 - 4/19

Author : Shul'man, A. R.; Pisarevskiy, A. N.

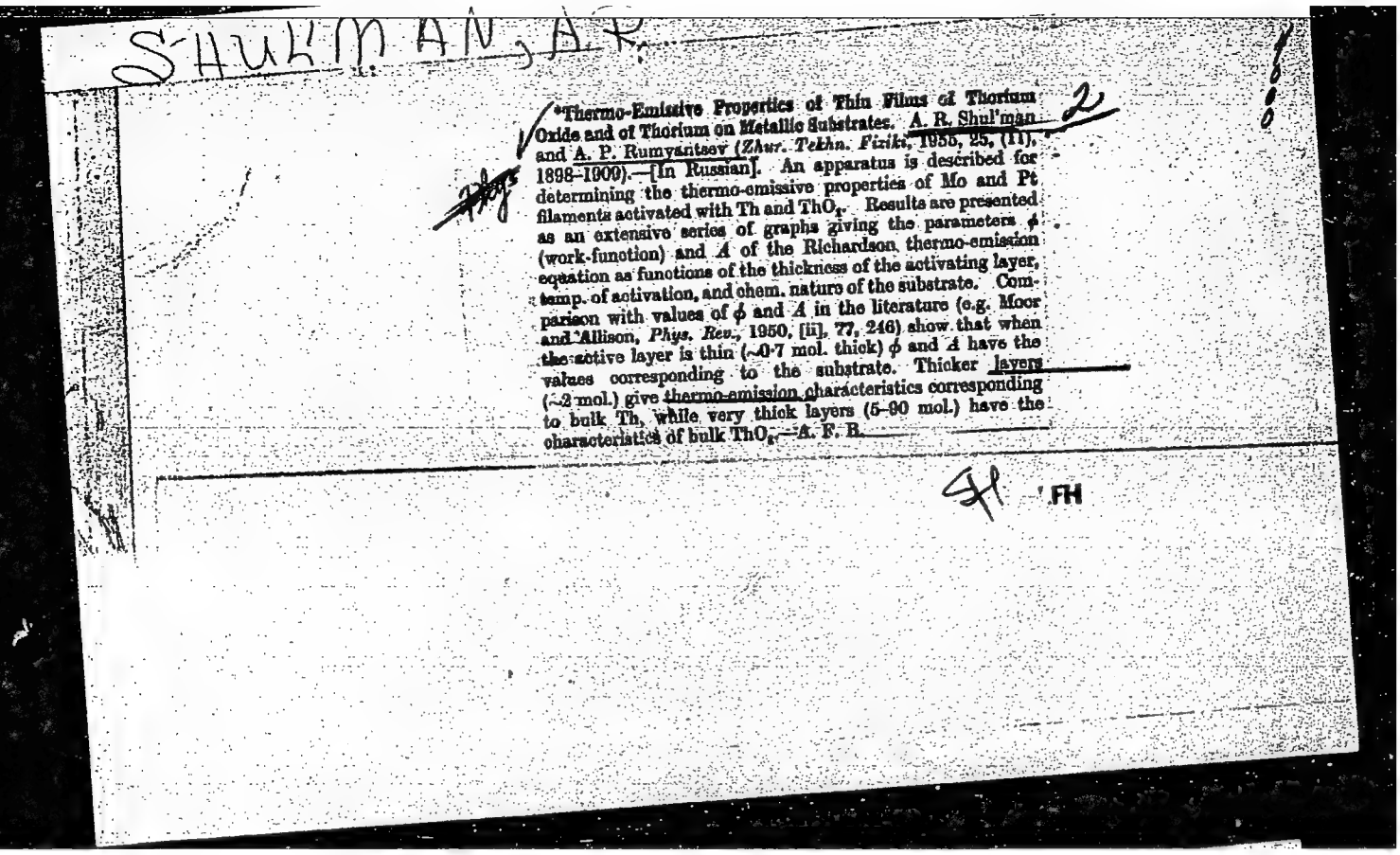
Title : Temperature variations in the work function of n-germanium and p-germanium

Periodical : Zhur. tekh. fiz., 25, No 9 (September), 1955, 1547-1555

Abstract : The authors pose the problem of simultaneously determining the temperature dependences of work function and position of level of chemical potential in n-germanium and p-germanium. In future works they will investigate also the electrical conductivity and thermo-emf of specimens. They claim that the literature contains no description indicating the behavior of the variation of chemical potential with temperature on the basis of direct experiments. They note that A. N. Arsen'yeva-Geyl' (ibid., this issue; see preceding abstract) has observed certain variation in the position of the Fermi level in germanium with temperature change. They describe procedure, control measurements, results, and conclusions (e.g. the existence of a definite temperature dependence of measured work function varying for n-germanium and p-germanium). Fifteen references, mostly Western. The authors thank Academician P. I. Lukirskiy, in whose laboratory the work was conducted, and also A. I. Stekhanov for preparation of the filters used.

Institution :

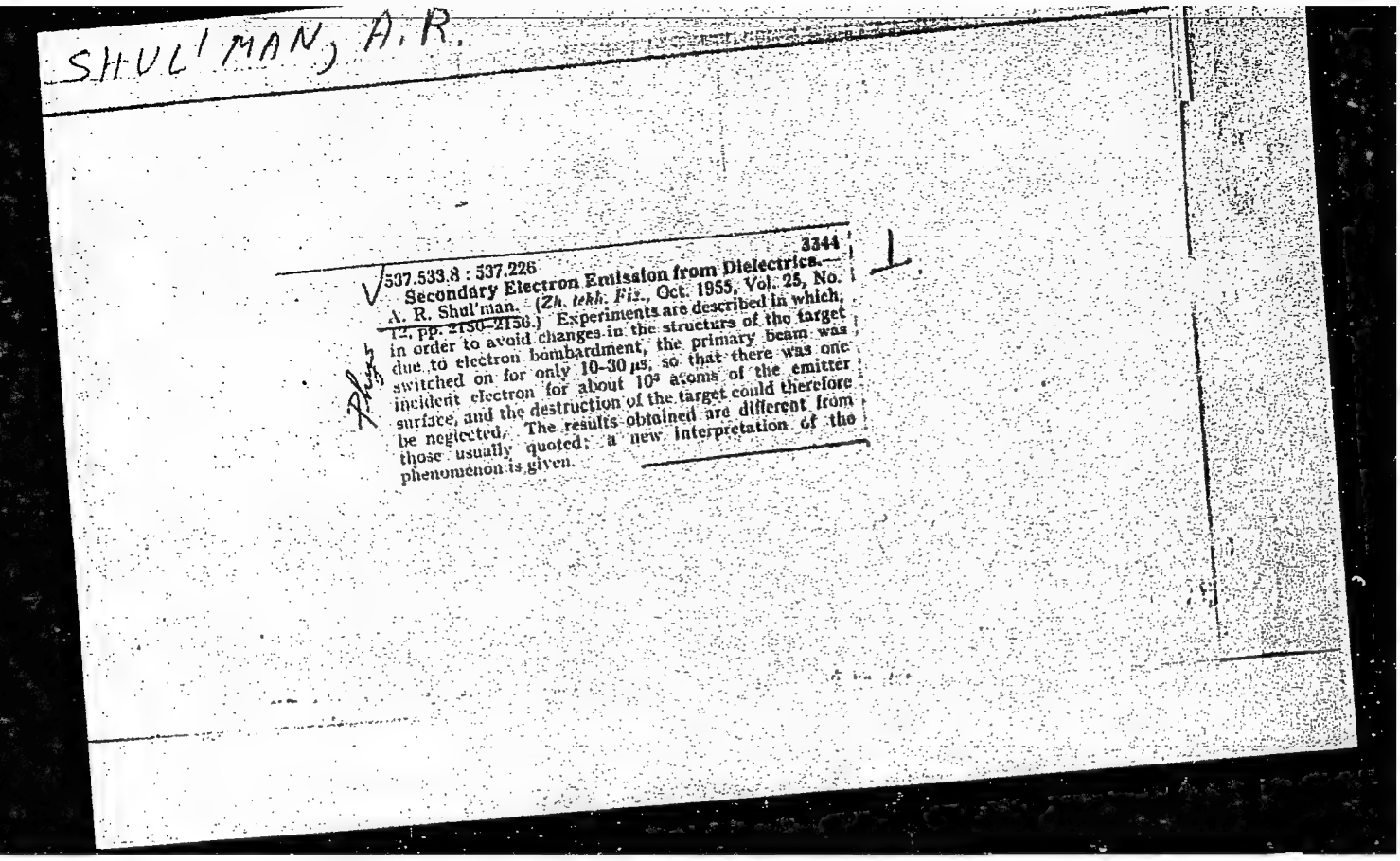
Submitted : January 18, 1955



SHUKMAN, A. F.

"Thermo-Emissive Properties of Thin Films of Thorium Oxide and of Thorium on Metallic Substrates. A. R. Shul'man and A. P. Rumyantsev (*Zhur. Tekhn. Fiziki*, 1955, 25, (11), 1898–1909).—[In Russian]. An apparatus is described for determining the thermo-emissive properties of Mo and Pt filaments activated with Th and ThO_2. Results are presented as an extensive series of graphs giving the parameters ϕ (work-function) and A of the Richardson thermo-emission equation as functions of the thickness of the activating layer, temp. of activation, and chem. nature of the substrate. Comparison with values of ϕ and A in the literature (e.g. Moor and Allison, *Phys. Rev.*, 1950, [ii], 77, 246) show that when the active layer is thin (~0·7 mol. thick) ϕ and A have the values corresponding to the substrate. Thicker layers (~2 mol.) give thermo-emission characteristics corresponding to bulk Th, while very thick layers (5–90 mol.) have the characteristics of bulk ThO_2.—A. F. B.

FH



SHUL'MAN, A. R.

3344

537.533.8 : 537.226

Secondary Electron Emission from Dielectrics.

A. R. Shul'man. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2150–2156.) Experiments are described in which, in order to avoid changes in the structure of the target due to electron bombardment, the primary beam was switched on for only 10–30 μs, so that there was one incident electron for about 10^3 atoms of the emitter surface, and the destruction of the target could therefore be neglected. The results obtained are different from those usually quoted: a new interpretation of the phenomenon is given.

FD-3146

USSR/Physics - Secondary electron emission

Card 1/2 Pub. 153 - 2/26

Author : Shul'man, A. R.; Dement'yev, B. P.

Title : Secondary electron emission from single-crystals of alkali-halide compounds

Periodical : Zhur. tekh. fiz., 25, No 13 (November), 1955, 2256-2263

Abstract : In their laboratory the authors earlier investigated the secondary emission properties of alkali-halide crystals, which turned out to be very convenient objects for the study of the principal laws of secondary electron emission (A. R. Shul'man, V. L. Makedonskiy, I. D. Yaroshetskiy, ibid., 23, 1152, 1953; A. R. Shul'man, ibid., 25, 1955). In the present article they describe further experiments in this direction. They obtain curves of the dependence $\sigma = f(V_p)$ for three alkali-halide single-crystals (KI, KBr, NaCl) and show that this dependence in dielectrics possesses a different form from that of metals. Their analysis of velocities of secondary electrons shows that in dielectrics most of the secondary electrons possess about identical energies in distinction to metals, in which the scatter of velocities of secondary electrons is comparatively large (6 to 8 times larger than in dielectrics). Variation of the curves of energy distribution of secondary electrons for various V_p and temperatures is found to be small, which evidently points to decrease in yield of secondary electrons which in large degree is caused by absorption of secondary electrons rather than by photon losses. The authors obtain

quantitative data on the temperature dependence of sigma o (the coefficient of secondary electron emission) in the substances investigated, and interpret the results obtained from the view point of the reality of the linear law of deceleration for primary electrons of medium velocities. Six references: e.g. L. N. Dobretsov, A. S. Titkov, DAN SSSR, 100, 33, 1955; N. D. Morgulis, N. G. Nakhodkin, DAN SSSR, 94, 1029, 1954.

Institution : -

Submitted : April 13, 1955

SHUL'MAN, A.R.; FARBSHTEYN, I.I.

Inelastic scattering of electrons in nickel and molybdenum targets. (MLRA 9:2)
Dokl.AN SSSR 104 no.1:56-59 S '55.

1.Leningradskiy politekhnicheskiy institut imeni M.I.Kalinina.
Predstavlena akademikom A.F.Ioffe.
(Electrons--Scattering) (Collisions (Nuclear physics)

SHUL'MAN, A.R.

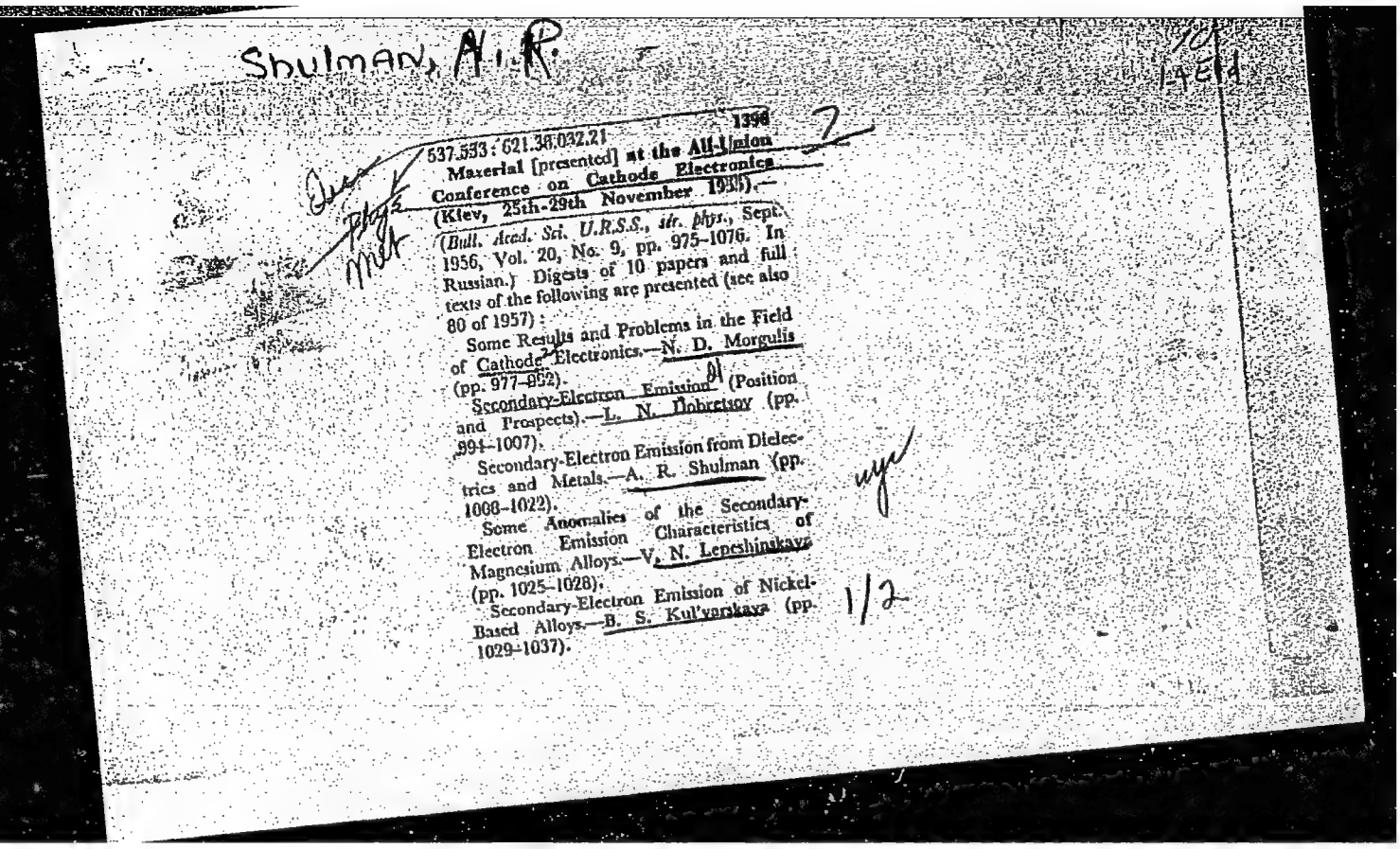
Interpreting experimental data on thermionic emission and electric conductivity of transistors. Trudy LPI no.181:149-156 '55. (MLRA 10:1)
(Transistors) (Thermionic emission)

SHUL'MAN, A.R.

Determining the relationship of temperature to the output og semiconductors and metals. Trudy LPI no.181:180-182 '55. (MLRA 10:1)
(Semiconductors)

SHUL'MAN, A. R. Doc Phys-Math Sci --(diss) "Study of the properties of secondary electronic emissions of dielectrics and metals." Len,1956. 22 pp 21 cm. (Min of Higher Education USSR. Len Polytechnic Inst im M. I. Kalinin), 100 copies

(KL, 7-57, 104



Shulman, A. R.

537.533 : 621.38.032.21 1398

Material [presented] at the All-Union Conference on Cathode Electronics (Kiev, 25th-29th November 1955).—(*Bull. Acad. Sci. U.R.S.S., sér. phys.*, Sept. 1956, Vol. 20, No. 9, pp. 975–1076. In Russian.) Digests of 10 papers and full texts of the following are presented (see also 80 of 1957):

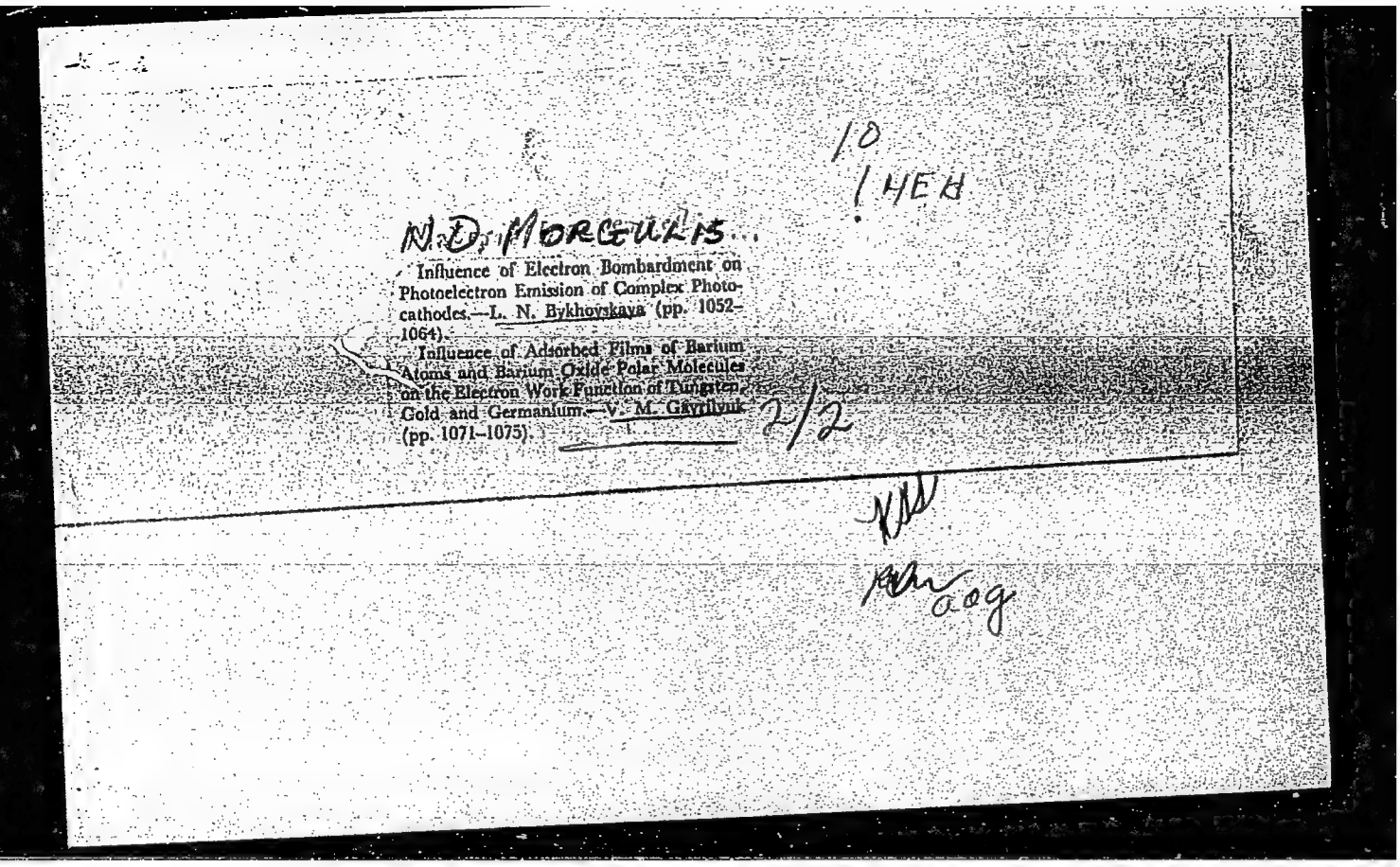
Some Results and Problems in the Field of Cathode Electronics.—N. D. Morgulis (pp. 977–982).

Secondary-Electron Emission (Position and Prospects).—L. N. Dobretsov (pp. 994–1007).

Secondary-Electron Emission from Dielectrics and Metals.—A. R. Shulman (pp. 1008–1022).

Some Anomalies of the Secondary-Electron Emission Characteristics of Magnesium Alloys.—V. N. Lepeshinskaya (pp. 1025–1028).

Secondary-Electron Emission of Nickel-Based Alloys.—B. S. Kul'yankaya (pp. 1029–1037).



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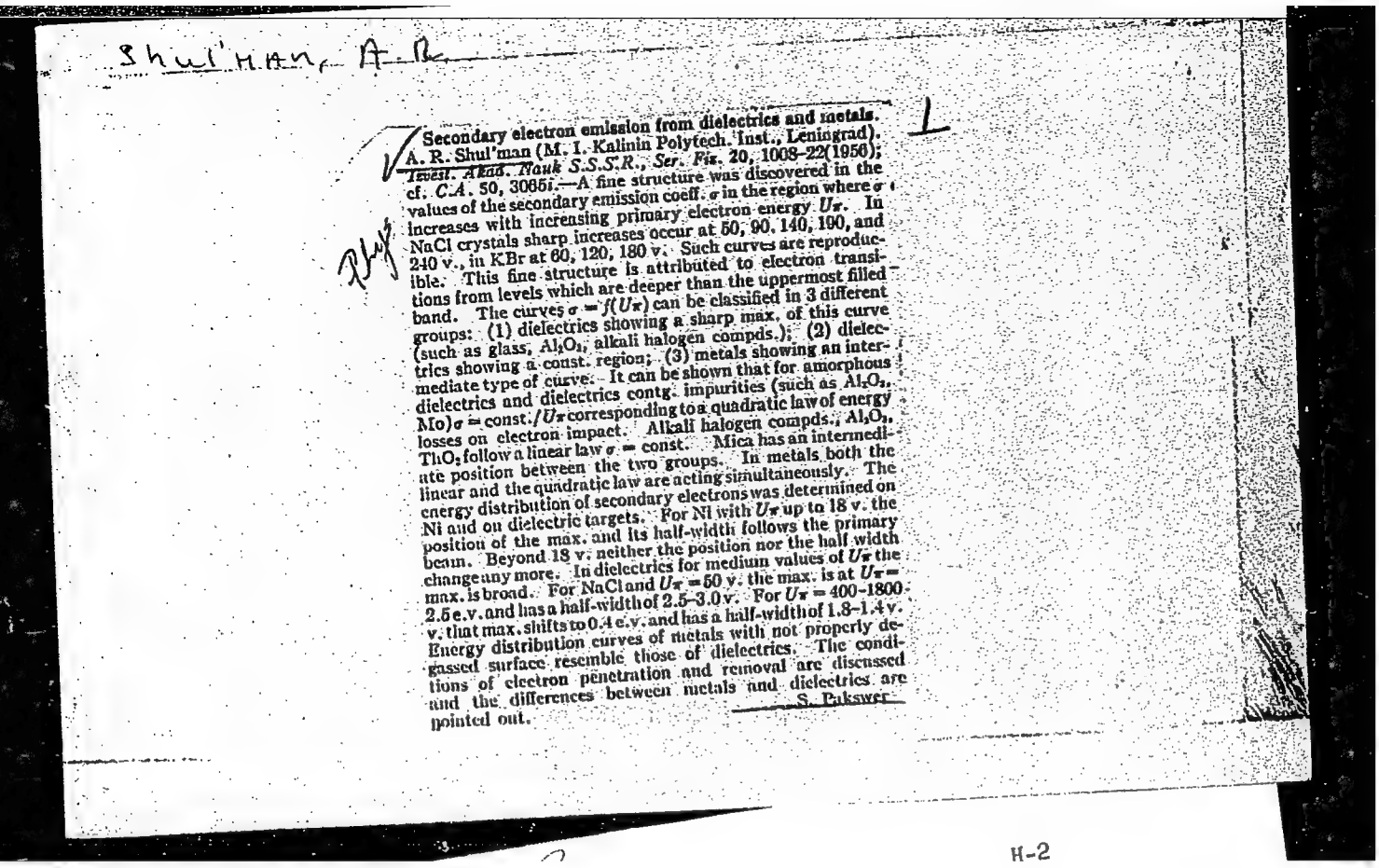
N.D. MORGULIS...

Influence of Electron Bombardment on Photoelectron Emission of Complex Photocathodes.—L. N. Bykhovskaya (pp. 1052–1064).

Influence of Adsorbed Films of Barium Atoms and Barium Oxide Polar Molecules on the Electron Work Function of Tungsten, Gold and Germanium.—V. M. Gavrilyuk (pp. 1071–1075).

2/2



Shul'man, A. R.

Secondary electron emission from dielectrics and metals. A. R. Shul'man (M. I. Kalinin Polytech. Inst., Leningrad). *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* 20, 1008–22(1956); cf. *C.A.* 50, 3065*i*.—A fine structure was discovered in the values of the secondary emission coeff. σ in the region where σ increases with increasing primary electron energy U_p. In NaCl crystals sharp increases occur at 50, 90, 140, 190, and 240 v., in KBr at 60, 120, 180 v. Such curves are reproducible. This fine structure is attributed to electron transitions from levels which are deeper than the uppermost filled band. The curves $\sigma = f(U_p)$ can be classified in 3 different groups: (1) dielectrics showing a sharp max. of this curve (such as glass, Al_2O_3, alkali halogen compds.); (2) dielectrics showing a const. region; (3) metals showing an intermediate type of curve. It can be shown that for amorphous dielectrics and dielectrics contg. impurities (such as Al_2O_3, Mo) $\sigma = \text{const.}/U_p$ corresponding to a quadratic law of energy losses on electron impact. Alkali halogen compds., Al_2O_3, ThO_2 follow a linear law $\sigma = \text{const.}$ Mica has an intermediate position between the two groups. In metals both the linear and the quadratic law are acting simultaneously. The energy distribution of secondary electrons was determined on Ni and on dielectric targets. For Ni with U_p up to 18 v. the position of the max. and its half-width follows the primary beam. Beyond 18 v. neither the position nor the half width change any more. In dielectrics for medium values of U_p the max. is broad. For NaCl and $U_p = 50$ v. the max. is at $U_p = 2.5$ e.v. and has a half-width of 2.5–3.0 v. For $U_p = 400$–1800 v. that max. shifts to 0.4 e.v. and has a half-width of 1.8–1.4 v. Energy distribution curves of metals with not properly degassed surface resemble those of dielectrics. The conditions of electron penetration and removal are discussed and the differences between metals and dielectrics are pointed out.

S. Pakswer

H-2

USSR/Electronics - Electronic and Ionic Emission

Abs Jour : Referat Zhur - Fizika, No 5, 1957, 12287

Author : Shul'man, A.R., Myakinin, Ye.I.

Inst : Leningrad Pedagogical Institute, Leningrad.

Title : Secondary Electron Emission From Nickel and Molybdenum at Low Primary-Electron Energies.

Orig Pub : Zh. tekhn. fiziki, 1956, 26, No 10, 2223-2233

Abstract : Measurements have been made of the dependence of σ on V_p along with a simultaneous analysis of the distribution of the secondary electrons by energies, using a spherical capacitor. The curves $\sigma = \int (V_p)$ have a minimum in the region $V_p \approx 4$ volts for molybdenum and in the region $V_p \approx 5$ volts for nickel. At lower energies one observes only elastic reflection of the primary electrons. At large V_p, there appear slow secondary and inelastically

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SHUL'MAN, A.B

109-3-4/23

AUTHORS: Shul'man, A.R., Zakirova, I.R., Morozov, Yu.A. and Fridrikhov, S.A.

TITLE: The Problem of the Method of Investigation of Secondary Electron Emission of Non-metallic Substances (K voprosu o metode issledovaniya vtorichnoy elektronnoy emissii nemetallicheskikh veshchestv)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol. III, No.3, pp. 329 - 338 (USSR).

ABSTRACT: Description of a method of the measurement of secondary electron emission is given. The method is characterised by the following features: reduction in the time necessary for the experiments, increased accuracy, good stability of the measuring system and the target and elimination of the ternary electrons. The main component of the experimental equipment used in the measurements is a spherical, glass bulb fitted with apertures for a target and an electron gun. Diameter of the sphere is 145 mm. The electron gun is of the standard type and is provided with a focusing electrode; it is also furnished with a reflecting diaphragm which eliminates the scattered electrons from the beam of the gun. The diaphragm is given a potential near to that of the cathode. The gun is screened by means of a nickel cylinder. The target is

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The Problem of the Method of Investigation of Secondary Electron Emission of Non-metallic Substances

in the form of a round, flat box having a diameter of 16 mm and is fitted with a helical heater. The target is fixed on to molybdenum supports and provided with a pair of leads for supplying the current to the heater. The heater can be earthed. The supporting wires of the target are taken to the input of an amplifier. The effect of ternary electrons is reduced by placing a spherical molybdenum grid, having a diameter of 125 mm, between the collector and the target. The transparency of the grid is of the order of 0.9. The grid has an aperture with a diameter of 40 mm for the leads of the target; another aperture, having a diameter of 16 mm, is provided for the primary electron beams (impinging on the target). Both the glass sphere and the grid are coated with silver by means of an evaporation process carried out in vacuum. For the analysis of secondary electron energies, a de-celerating potential U_3 is applied between the target and the grid; a potential U_g is applied between the grid and the collector, which accelerates the secondary electrons and slows down the ternary ones. The full experimental equipment (which was built around the spherical condenser) is shown in Fig.1. This consists of

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the above mentioned electron gun, the collector and the anti-dynatron grid and contains the following units: supplies for the electron gun, a rotary potentiometer, supplies for the potentiometer, a synchronous motor, a registering instrument, a delay circuit, a rectangular pulse generator, an amplifier, a pulse lengthener, an oscillograph with a triggered time base; an automatic switching device and a synchronous motor driving the tape of the registering device. The functioning of the equipment and its applicability to the measurement of the secondary electron emission was thoroughly investigated. It was found that the equipment could be used for single-pulse measurements as well as for the investigation by means of periodically repeated pulses; in particular, it was possible to obtain good reproducibility of the secondary emission coefficient. The effect of the anti-dynatron grid on the secondary emission current is illustrated by the curves of Figs. 5, 6, 7 and 8. From these, it is concluded that U_g should be of the order of 100 V. The stability of the primary electron current is an important factor in the equipment, especially when the de-celerating potential U_3 is varied;

The Problem of the Method of Investigation of Secondary Electron Emission of Non-metallic Substances

it was found that the primary current as a function of U_3 did not vary more than 1 to 2%. Some measurements on the distribution of the secondary electron energies were carried out. The resulting curves are shown in Fig. 12. The Curve 1 of Fig.12 was taken for Ni at $U_3 = - V_p$ (where V_p is the accelerating potential of the primary electrons); this curve is in good agreement with the results obtained by R. Warnecke (Ref.11), which are represented by Curve 2.
There are 12 figures and 12 references, of which 6 are English, 5 Russian and 1 German.

SUBMITTED: February 18, 1957

AVAILABLE: Library of Congress

SOV/[illegible]-3-8-5/[illegible]

SHUL'MAN, A. R.

AUTHORS: Kapitsa, M.L., Mel'nikov, A.I., Morozov, A.V., Popov, B.N., Sobolevskaya, R.B., Tsarev, B.M. and Shul'man, A.R.

TITLE: Thermionic Properties of Barium Tungstate (Termoelektronnyye svoystva vol'framata bariya)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol 3, Nr 8, pp 1010 - 1016 (USSR

ABSTRACT: The work described was concerned with the investigation of the thermionic emission of barium tungstate and Ba_2CaWO_6. The investigation was undertaken since it was thought that the resulting data might be useful in explaining the operation of the pressed cathodes and other cathodes which contain barium tungstate, The investigations were carried out on directly heated cathodes which were based on tungsten and molybdenum cores. The measurements were made on special experimental diodes, fitted with protective anodes. The cathode temperature was determined by measuring the change in the resistance of the core. All the measurements were done under static conditions. The coating of Ba_3WO_6 and Ba_2CaWO_6 were effected by two methods: a) a filament of the core metal was passed through a drop of the coating substance mixed with a binder; b) cataphoretic coating was used. In the first case, coarse-grain coatings were obtained, while the second method permitted obtaining the particles having a diameter of about 1 - 5 u. The cathodes were de-gased by heating up to 1 250 °K for the duration of 1 - 2 hours without taking any current. This processing resulted also in a partial activation of the cathodes. Further activation of the

cathodes (by heating and taking the current) was then carried out. During the preliminary activation, it was found that the work function (as measured from the Richardson curves) was of the order of 2.2 eV, while after the final activation, the work function dropped to 1.2 - 0.5 eV. The characteristics of a barium-tungstate cathode after final activation are shown in Figure 2. The emission current and the work function of the same cathode for various activating temperatures are given in Table 1. On the other hand, it was found that the cathodes of Ba_2CaWO_6 had very low emission densities. These were of the order uA/cm^2, as can be seen from Table 2. By comparing the results of Table 2 with those for Ba_3WO_6 (given in Table 3), it is seen that the emission of the latter is about 100 times higher than that of the former. It was found that the curve:

for the cathode of barium tungstate consists of three regions (Figure 4). At low temperatures (below 900 °K), the curve has the highest slope; the work function in this region is equal to 1.3 eV. In the regions of temperatures from 900 - 1 250 °K, the work function has a value of about 0.6 - 0.7 eV. Finally, at temperatures above 1 250 °K, the current decreases as a function of temperature and the slope of the curve cannot be regarded as representing the work function.

Thermionic Properties of Barium Tungstate SOV/[illegible]

There are 5 figures, 5 tables and 4 references, 3 of which are Soviet and 1 English.

SUBMITTED: January 29, 1958

1. Barium tungstates--Properties 2. Thermionic emission--Analysis
3. Cathodes--Performance

SHUL'MAN, A.R.

57-1-13/30

AUTHORS: Shul'man, A. R., Zakirova, I. R., Morozov, Yu. A., Fridrikhov, S. A.

TITLE: Secondary Electron Emission of Nickel (Vtorichnaya elektronnaya emissiya nikelya)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 1, pp. 87-96 (USSR)

ABSTRACT: The task of the present work was to close the gaps existing in literature regarding the energy spectra of secondary electrons emitted by metals, as well as to obtain data on the distribution of secondary electrons according to energies in nickel. That is to say of all those which are emitted within the whole range of secondary electron energy at various V_p (energy of primary electrons) of from 2oo to 2ooo V with nickel. Starting from the data on the distribution of secondary electrons according to energies the problem of the importance of the quantities obtained at the investigation of the basic dependence (which characterizes the secondary emission characteristics of the material - of the dependence of the coefficients of the electron emission on V_p) is dealt with. The method of spherical condenser with a spheric

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Secondary Electron Emission of Nickel

suppressor grid was used. The method of the automatic recording of measuring results, as described in reference 2, was also used. As result of the investigation the following can be stated: 1) Tertiary electrons emitted from the collector exercize an essential influence on the measuring results of secondary current in the retarding field. The introduction of the suppressor grid offers the possibility to essentially decrease the influence of tertiary electrons and thereby to obtain much more reliable data than was earlier the case. The distribution of the secondary electrons according to the energies of from 0 to V_p was investigated. Complete lag curves for nickel were obtained at V_p of from 2oo to 2ooo V. 2) In the spectrum of the secondary electrons it is not possible to draw a limiting line between the reflected primary and the real secondary electrons. Apparently both kinds of electrons are represented in all parts of the spectrum. With small energies of secondary electrons assumption that real secondary electrons are of dominating importance is reasoned. For the analysis of the energy spectrum of electrons (of nickel) an assumed border between slow and quick secondary electrons, equal to

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Secondary Electron Emission of Nickel

loo eV, is chosen. 3) The basic fact resulting from the measurements is that in the spectrum of secondary electrons of metals the relative number of quick electrons can be compared with that of slow electrons. The width of the maximum corresponding to the slow real secondary electrons is a little greater than was earlier assumed. In order to mark the number of quick secondary electrons magnitudes are introduced as follows: γ - the part of quick electrons in secondary current and η - the ratio between the number of quick electrons and the quantity of the primary current. γ increases linearly with the increase of V_p and reaches up to 26% of the total number of secondary electrons at 1600. η is only little dependent on V_p and is equal to 33% of the primary current value at 1600. 4) The retardation vurves in relative coordinates coincide with one-another only if V_p is greater than 1200 V. If V_p values are smaller the curves differ. 5) With all values applied for V_p an elastic reflexion of primary electrons takes place. The reflection coefficient at $V_p > 800$ V is not greater than 3% of the total number of primary electrons. 6) When primary current is measured in the circuit of the target in the case of not complete

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Secondary Electron Emission of Nickel

blanking of secondary electrons for the coefficient of secondary emission σ_T a value was obtained which differs from that of total retardation of secondary electrons. 7) In order to mark the emission of slow electrons the magnitudes σ_T and δ can be used (coefficient of the emission of slow electrons). As the existing theories only take into account the stimulation of secondary electrons by primary electrons and as inelastic reflection of primary electrons and the formation of slow secondary electrons with the motion of quick secondary and of inelastically reflected primary electrons are not taken into account, the comparison between theoretical and experimental data can not be carried out with sufficient exactness. There are 12 figures and 8 references, 2 of which are Slavic.

ASSOCIATION: Leningrad Polytechnical Institute imeni M. I. Kalinin (Leningradskiy politekhnicheskiy institut imeni M. I. Kalinina)

Secondary Electron Emission of Nickel 57-1-13/30

SUBMITTED: March 5, 1957

AVAILABLE: Library of Congress

Card 5/5

SHUL'MAN, A.R.

Work function of thin films of thorium oxide and thorium on tungsten. Zhur. tekh. fiz. 28 no. 8:1711-1713 Ag '58. (MIRA 11:10)

1. Leningradskiy politekhnicheskiy institut imeni M.I.Kalinina.
(Thorium oxides)
(Thorium)
(Tungsten)

BAZHANOVA, N.P. [translator]; FRIDRIKHOV, S.A. [translator]; KAPITSA, M.L.[translator]; LEPESHINSKAYA, V.N. [translator]; SHUL'MAN, A.R., red.; POPOV, R.Yu., red.; KLIMENKO, S.V., tekhn.red.

[Characteristic energy losses of electrons in solids; collection of articles] Kharakteristicheskie poteri energii elektronov v tverdykh telakh; sbornik statei. Moskva, Izd-vo inostr.lit-ry, 1959. 270 p. (MIRA 12:7)

1. Sotrudniki kafedry elektroniki Leningradskogo politekhnicheskogo instituta (for Bazhanova, Fridrikhov, Kapitsa, Lepeshinskaya).
(Electrons)

67312

~~9 (3), 24 (3)~~ 4. 3120 SOV/181-1 8-17/32

AUTHORS: Fridrikhov, S. A., Shul'man, A. R.

TITLE: Investigation of Secondary Electron Emission of Some Dielectrics with Low Primary Electron Energies

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1 , Nr 8, pp 1259 - 1267 (USSR)

ABSTRACT: The present paper gives part of the results of the experiments carried out in the authors' laboratory on secondary electron emission of some dielectrics and semiconductors (mica, glass, alundum, fluorite, willemite, stibnite, etc) for low primary electron energies. Measurements were made by the pulse method, and an accuracy of 3 to 5% was attained when periodic pulses were used. The $\sigma = f(V_p)$ curve (V_p denoting primary electron energy) has a clearly marked minimum with v_p = 60 to 70 v. The first critical potentials of the substances investigated are summarized in a table. With low primary electron energies the $\sigma(V_p)$ function depends on elastic and inelastic reflection of the primary electrons and on the emission of the true secondary electrons. From some definite V_p values in the range of low

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Investigation of Secondary Electron Emission of Some Dielectrics With Low Primary Electron Energies

energies onwards the slowing-down curves have a slope which corresponds to a group of slow, obviously true secondary electrons. In metals elastically reflected electrons play the main part. If the electron energies are lower than V_p, then the electrons of the base zone cannot be excited. Therefore, these secondary electrons seem to be inelastically reflected primary electrons with an energy $< V_p$. The high values of the reflection coefficient R and of σ cannot be explained only by reflection of the primary electrons from the potential barrier on the surface of the substance. Electron - phonon collisions play the main part in slow primary electron reflection in the range of small V_p. This also explains the high R and σ values and the existence of electrons with energies $< V_p$ in the electron spectrum. The $\delta = \delta(V_p)$ curves and, thus, also the $\sigma = f(V_p)$ curves for the various substances differ considerably from one another in the V_p range investigated. δ is determined essentially by the primary electrons which are inelastically scattered by

Investigation of Secondary Electron Emission of Some Dielectrics With Low Primary Electron Energies

phonons only at very low V_p. With a certain quantity V_p which is characteristic of every substance interactions between primary electrons and the electrons of the substance begin to play the main role. Some conclusions: The first critical potentials V_p^I do not depend on temperature. The coefficient R of elastic electron reflection is relatively great (0.6 to 0.7) in the range of very small V_p (2 to 3 v) for all dielectrics investigated, which is probably caused by quasielastic scattering of primary electrons from phonons. The $R = R(V_p)$ curves differ only slightly from one another in the substances investigated. In this V_p range the σ values are relatively great and do not differ much for the various substances. With increasing V_p, however, secondary electron emission begins to differ considerably for various substances. The σ values for

Investigation of Secondary Electron Emission of Some Dielectrics With Low Primary Electron Energies SOV/181-1[illegible]-8-17/32

average V_p are not unambiguously determined by the σ values with small V_p. There are 9 figures, 1 table, and 9 references, 5 of which are Soviet.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina (Leningrad Polytechnic Institute imeni M. I. Kalinin)

SUBMITTED: August 5, 1958

9.3120

~~9 (3)~~

67313

AUTHORS: Fridrikhov, S. A., Shul'man, A. R. SOV/181-1-8-18/32

TITLE: Investigation of Secondary Electron Emission of Alkali Halide Single Crystals With Low Primary Electron Energies

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 8, pp 1268 - 1271 (USSR)

ABSTRACT: The authors report on part of the work carried out in their laboratory concerning secondary electron emission of dielectrics with low energies of the bombarding electrons. Measurements were carried out by pulse methods. The measuring device has been described already in an earlier paper. The beam of primary electrons came in perpendicularly to the plane (100). During the measurements pressure was 2.10^{-7} torr. The results of measurements made with various single crystals are illustrated in a diagram by curves $\sigma = f(V_p)$. σ denotes the secondary electron emission, V_p the counter potential applied to the collector. In the case of small V_p σ actually does not increase monotonely, for the real function $\sigma(V_p)$ has several breaks. For NaCl, e.g., σ begins to increase considerably at

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Investigation of Secondary Electron Emission of Alkali Halide Single Crystals With Low Primary Electron Energies

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50, 90, 140, 190, and 230 to 240 v. This "fine structure" is easily reproducible. Each of the alkali halide salts investigated (LiF, NaF, NaCl, KCl, KBr, KJ) has a proper "fine structure" of the curves. σ increases with decreasing width of the forbidden zone ΔE_f of the crystals. With V_p = 240 v, σ decreases about linearly with increasing forbidden zone width. The lower the ratio $\Delta E_f/\chi$ (where χ denotes electron affinity), the greater is σ. If V_p is of an order of several hundred v, then secondary electron emission usually is low in the case of substances with small forbidden zone width; for on their way to the surface, secondary electrons may lose much of their energy when interacting with the electrons of the ground band. In the single crystals of the alkali halide compounds investigated conditions for secondary electron emission are very favorable. In the experiments described all the conditions for the occurrence of secondary electrons are important: The observed σ values are determined by the energy which must be consumed for the transfer of the lattice electron from the

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Investigation of Secondary Electron Emission of Alkali Halide Single Crystals With Low Primary Electron Energies

SOV/181-1-8-18/32

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina (Leningrad Polytechnic Institute imeni M. I. Kalinin)

SUBMITTED: August 5, 1958

Card 4/4

SOV/109-4-4-24/24

AUTHORS: Vasil'yev, G.F., Politova, N.N., Shabel'nikova, A.E., Pervova, L.Ya. and Yasnopol'skaya, A.A.

TITLE: Interdepartmental Seminar on Cathode Electronics (The 11th Meeting) (Mezhduvedomstvennyy seminar po katodnoy elektronike) (11-e zasedaniye)

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 4, pp 731 - 732 (USSR)

ABSTRACT: A meeting of the seminar took place on December 1, 1958 at the Institut radiotekhniki i elektroniki AN SSSR (Institute of Radio-engineering and Electronics of the Ac.Sc.USSR). During the meeting 8 papers were read. Yu.G. Ptushinskiy read a paper entitled: "Kinetics of the Adsorption of Oxygen on the Surface of Tungsten". The second paper, by I.M. Dykman and S.M. Pekar, dealt with "The Admixture Photo-effect of Semiconductors in the Region of the Exciton Light Absorption". The paper by T.L. Matskevich was devoted to "The Problem of the Secondary Electron Emission of Fine Films of a Number of Organic Substances". The problem of "Surface Ionisation in a Strong Electric Field on a Surface with a Non-homogeneous Work Function" was considered by E.Ya. Zandberg and N.I. Ionov. I.N. Bakulina and N.I. Ionov read a paper entitled "Determination of the Electron Attachment Energy and of the Potentials of Atoms by the Method of Surface Ionisation". N.L. Yasnopol'skiy and A.P. Alekseyev dealt with the problem of "Passage of Steady-state Currents Through a Dielectric When the Current Carriers Are Introduced Through One of the Contacts by Means of Electron Bombardment". The lecture by D.A. Ganichev and K.G. Utkin discussed the following - "The Possibility of the Analysis of the Total-energy Distribution of Electrons in a Quasi-spherical Condenser". The work by M.L. Kapitza, S.A. Fridrikhov and A.R. Shul'man dealt with an investigation of the secondary electron emission and the characteristic energy losses of a number of dielectrics (glass, mica, fluorite and alkali-haloid monocrystals).

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Card 2/2

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B006/B017

24.7700

AUTHORS: Kapitsa, M. L., Fridrikhov, S. A., Shul'man, A. R.

TITLE: Characteristic Energy Losses in the Reflection of Electrons From Single Crystals of Alkali Halide Compounds

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 3, pp. 517-523

TEXT: In a previous paper (Ref. 5) the two last-mentioned authors had already investigated inelastic electron reflection from alkali halide crystals, and they had found that the energy spectrum of secondary electrons (which are emitted by alkali halide single crystals) showed fine structure (Fig. 1 shows such a spectrum recorded on NaCl with a primary electron energy of V_p = 30 ev). Such curves were also recorded on KCl, KBr, KI, and LiF. It was the aim of the present paper to conduct analogous investigations with higher accuracy and with small V_p in order to find the lower boundary of primary electron energy at which peaks of the characteristic losses can still be perceived in the secondary electron spectrum; furthermore, an attempt was made to separate the two possible

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Characteristic Energy Losses in the Reflection of Electrons From Single Crystals of Alkali Halide Compounds

systems of maxima (the so-called right system of primary electrons and the left system of secondary electrons; the position of the maxima of the latter is independent of V_p). The measuring technique is described in detail. The spectrum was measured automatically at a target temperature of 300 - 350°C, a primary current density of 10^{-7}a/cm^2, and a pressure of $\sim 2.10^{-7}$torr; V_p was between 0.5 and 50 ev. Fig. 3 shows the spectra of the electrons reflected from NaCl single crystals at V_p = 30, 32, and 34 ev. The two systems of maxima can be clearly seen. Fig. 4 shows spectra of electrons reflected from NaCl at V_p = 5, 7, 9, 11, and 13 ev, and Fig. 5 depicts the spectrum at V_p = 21.5 ev. Important loss peaks occurred only at $V_p > 7$ ev. The peaks correspond to energy losses of about 1 - 1.2, 1.7 - 2, 2.6 - 2.8, 3.8 - 4.3, 5 - 5.4, 6 - 6.7, 7.5 - 8.1, 9 - 9.6, and 11 ev. The probability of higher energy losses rises with increasing V_p. The fine structure proved to be characteristic of the substance investigated. In conclusion, the results are discussed. Although the right system of maxima can be clearly attributed to the characteristic energy losses of electrons, the nature of the left system, however, needs further

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81365

Characteristic Energy Losses in the Reflection of Electrons From Single Crystals of Alkali Halide Compounds

S/181/60/002/03/23/028
B006/B017

investigations. A relationship could be observed between the energy losses below 12 ev and optical data (cf. Table). Furthermore, it was established that the least primary electron energy at which characteristic energy losses still occurred (7 ev) was smaller than the width of the forbidden zone. There are 5 figures, 1 table, and 14 references: 4 Soviet, 6 US, 2 Japanese, 1 British, and 1 German.

ASSOCIATION: Leningradskiy politekhnicheskiy institut (Leningrad Polytechnic Institute)

SUBMITTED: June 6, 1959

Card 3/3

SHUL'MAN, A.R.; GEL', E.P.

Depth of coloring of alkali halide crystals when bombarded by 6 to 15 kv. electrons at different angles. Fiz. tver. tela 2 no.3:524-529 Mar '60. (MIRA 14:8)

1. Leningradskiy politekhnicheskiy institut imeni M.I.Kalinina.
(Electron beams) (Color centers) (Alkali metal halides)

81366
S/181/60/002/03/25/028
B006/B017

24.7700

AUTHORS: Shul'man, A. R., Ganichev, D. A.

TITLE: Secondary Electron Emission and Elastic Reflection of Electrons From Germanium Single Crystals at Low Electron Energies

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 3, pp. 530-536

TEXT: In the introduction, investigations of the same problems by other authors are briefly described. The present paper reports on investigations of the secondary emission of oriented germanium single crystals in the range of primary electron energy 1 ev $< V_p \leq 50$ ev. Measuring technique and apparatus are described in detail. Static measurements were made with very low primary current densities ($j \leq 10^{-8} a/cm^2$) in a well compensated geomagnetic field (residual field 0.03 oe). The energy analysis of secondary electrons was made by the method of the spherical condenser (diameter of the outer sphere: 130 mm). The electron beam of 1 - 100 ev was produced with an electron gun which is schematically shown

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Secondary Electron Emission and Elastic Reflection of Electrons From Germanium Single Crystals at Low Electron Energies

in Fig. 1. p-type germanium single crystals (resistivity: 20 ohm.cm) were finely ground and applied to the prepared molybdenum targets. The measurements were made with two different samples. The electron beam focusing was controlled by four different methods discussed here. The results of these measurements were satisfactory, and it was found that the primary current was independent of V_p and the collector potential. Fig. 2 shows $\sigma = \sigma(V_p)$ for a perpendicular incidence of the electron beam on the (100) surface. This shows that with the increase of V_p from 1 to 10 v, σ increases monotonically. In the energy range 1 - 50 v the $\sigma(V_p)$-curve shows a more irregular course and has a maximum at about 10 v, a minimum below a 20 v, and still an irregular increase (Fig. 3). This diagram also shows $R(V_p)$ and $\delta(V_p)$ in the same range. Fig. 4 shows $R(V_p)$ and $\sigma(V_p)$ for the germanium single crystal and a germanium film sputtered on tungsten in the range 1 - 25 v. At the same time with $\sigma(V_p)$ also the delay curves of the secondary collector current were recorded for different V_p values. Fig. 5 shows such values for $V_p < 5$ v, Fig. 6 for $4.5 \leq V_p \leq 10.5$ and Fig. 7 for $V_p = 30.5$ v. The behavior of these curves

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Secondary Electron Emission and Elastic Reflection of Electrons From Germanium Single Crystals at Low Electron Energies

S/181/60/002/03/25/028
B006/B017

partly deviates from that of metals. For comparison, Fig. 8 shows the germanium delay curves and those of tungsten. The data obtained indicate that single crystals and sputtered films of germanium have different properties. As a rule, single crystals have distinct characteristic features in the curves, which are weakened in the films or not present at all. A comparison of the delay curves of metals, dielectrics, films, and single crystals shows that single crystals of dielectrics have the steepest curves. It was found that the coefficient of elastic reflection R from germanium single crystals increases in the range $1 \leq V_p \leq 8$ ev and passes through a maximum at about 8 ev. In the range $8 \leq V_p \leq 50$ ev it decreases, but not monotonically. The irregular course of $R(V_p)$ cannot be explained by assuming primary electron reflection from a potential barrier. In this case, the surface- as well as the volume properties of the crystal must be taken into account. In single crystals, the absolute value of R is higher than in films. There are 8 figures and 8 references: 5 Soviet and 2 US.

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81366

Secondary Electron Emission and Elastic Reflection of Electrons From Germanium Single Crystals at Low Electron Energies

S/181/60/002/03/25/028
B006/B017

ASSOCIATION: Politekhnicheskiy institut im. M. I. Kalinina Leningrad
(Polytechnic Institute imeni M. I. Kalinin, Leningrad)

SUBMITTED: June 29, 1959

Card 4/4

MEL'NIKOV, A.I.; MOROZOV, A.V.; SOBOLEVSKAYA, R.B.; SHUL'MAN, A.R.

Thermionic emission from barium tungstate. Fiz. tver. tela 2 no.4: 704-708 Ap '60. (MIRA 13:10)
(Barium tungstate) (Thermionic emission)

S/181/60/002/011/021/042
B006/B056

9,4160 (3201, 1003, 1137)

AUTHORS: Shuliman, A. R., Kapitsa, M. L., Nemchenok, R. L., and Zelenetskaya, Ye. V.

TITLE: Photoelectric Emission of the Systems W-BaO and W-Ba

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 11, pp. 2805-2812

TEXT: The authors' aim was a comprehensive investigation of the photoelectric properties of the W-BaO and W-Ba systems, a comparison of the properties of these two systems, and a study of the nature of the photoeffect of these systems. First of all, the measuring method is described. Fig. 1 gives a schematic representation of the device working in plane geometry. Figs. 2 and 3 show typical spectral characteristics of W-BaO systems. On the whole it could be observed that the quantum yield increases monotonically with the layer thickness. In the series of measurements illustrated in Fig. 3, however, this was not the case, which may be explained by the somewhat less favorable vacuum conditions. The work function of the tungsten backing (10 - 25μ) measured by the Fowler method was found to be 4.3 - 4.4 ev, whereas the Richardson method yielded a value of 4.5 - 4.6 ev. The yield curves were evaluated according to Fowler, and the

Photoelectric Emission of the Systems W-BaO and W-Ba

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result (Fig. 4) is discussed. The spectral characteristics of the photoemission of the W-Ba system take a similar course as those of W-BaO. It is, however, partly smoother and without any noticeable connection between quantum yield and layer thickness. Figs. 5 and 6 show the characteristics; those shown in Fig. 6 were recorded at a much lower rate of sputtering. Fig. 7 shows the Fowler curves which take a similar course as those of the W-BaO system. Summing up: 1) An investigation was carried out of the change in the work function (Fig. 8 shows the work function as a function of the sputtering time on a cold backing) and of the quantum yield for a thickness from 0 to 3 - 10 monomolecular layers (Figs. 2-6). 2) The spectral characteristics of the photoeffect of W-Ba are largely monotonic up to a thickness of about 10 monomolecular layers, except for a thickness of about one layer, where the characteristic takes an anomalous course. 3) The spectral characteristics of the system W-BaO showed no peculiarities for a thickness of less than one monomolecular layer, and in photoemission the photoelectrons of the metal with reduced work function play the main part. 4) For BaO coatings on a W-base with a thickness of more than one monomolecular layer, the quantum yield curves show peculiarities which cannot be ascribed neither to the properties of the W-backing nor to BaO. Thus, BaO coatings of a thickness of one or several molecules

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Photoelectric Emission of the Systems W-BaO and W-Ba

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B006/B056

not only cause a decrease of the work function of the metal, but also change the emission mechanism. Yu. S. Vedula and V. M. Gavrilyuk are mentioned. There are 8 figures and 9 references: 5 Soviet, 2 US, 1 Japanese, and 1 German.

ASSOCIATION: Politekhnicheskiy institut im. M. I. Kalinina Kafedra elektroniki Leningrad (Polytechnic Institute imeni M. I. Kalinin, Chair of Electronics, Leningrad)

SUBMITTED: July 1, 1960

Legend to Figs. 2, 5: The numbers of the curves denote the sputtering time. The higher the number, the longer the duration.
Legend to Fig. 8: 1) Source - barium beryllate, $5 \cdot 10^{-8}$ mm Hg; 2) the same source, $5 \cdot 10^{-9}$ mm Hg; 3) and 4) "Bati" source, $5 \cdot 10^{-9}$ mm Hg.

Card 3/5

64127

S/109/60/005/05/015/021
E140/E435

24.2130

AUTHORS: Shul'man, A.R., Kirsanova, T.S. and Pavlov, V.K.

TITLE: The Work Function of Thin Films of Barium Oxide on a Tungsten Base

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol 5, Nr 5, pp 840-848 (USSR)

ABSTRACT: The dynamic variation of barium-oxide work function at various temperatures of a tungsten base is determined. The process is more complicated than in the case of metal-atom films, since along with evaporation and migration the film state is effected through chemical reactions with the base material. The film thickness was estimated from optical measurements and deposition time. Measurements of work function indicated the following: a) The variation of work function with film thickness has a monotonic character. b) The curve of film work function against thickness at various rates of deposition does not vary appreciably. Although there are certain common features in the behaviour of barium and barium-oxide films on tungsten base, the barium-oxide films are subject to different laws from the barium films.

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69927
S/109/60/005/05/015/021
E140/E435

The Work Function of Thin Films of Barium Oxide on a Tungsten Base

For barium the work function curve has a minimum, for barium oxide monotonic curves are obtained. The results are closer to those obtained by V.M.Gavrilyuk (Ref 3,5) than those of Russel and Moore (Ref 1,2). It is concluded that the processes occurring with heating of the films are fairly complex and it is not possible to explain them by any single phenomenon, for example evaporation, but at least two processes occur, one of which leads to increase and the other to decrease of the work function. Therefore, deactivation curves of the barium-oxide-tungsten system cannot be directly treated as desorption curves. Further experimental work is necessary in which the assumed elementary processes can be separated. There are 7 figures, 1 table and 5 references, 2 of which are Soviet, 1 English and 2 English in Russian translation.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M.I.Kalinina (Leningrad Polytechnical Institute imeni M.I.Kalinin)

SUBMITTED: July 6, 1959

Card 2/2

26.2312
9.3120 (1003, 1137, 1140)

S/109/60/005/008/005/024
E140/555

AUTHORS: Kirsanova, T.S., Shul'man, A.R. and Engovatova, N.I.

TITLE: Emissivity of Thin Barium Oxide Films on Metal Bases

PERIODICAL: Radiotekhnika i elektronika, 1960, Vol.5, No.8, pp.1225-1232

TEXT: In the study of thin films, the emissivity provides a fuller evaluation of the state of the system than a knowledge of work function. Further, emissivity is of independent interest since, in the last analysis, it is precisely emissivity that is the important characteristic. Nevertheless both indices give only aggregate results and are no measure of the individual elementary processes (evaporation, migration, chemical reaction, etc.). The present work therefore studies the variations of emissivity of thin barium oxide films on tungsten occurring as a result of prolonged heating at various temperatures. The results of the study indicate that the emissivity of these systems depends substantially on temperature and on the heat-treatment cycle of the films. Optimum emissivity is obtained at definite temperatures. This is taken to indicate that variations in film state are not connected only with

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S/109/60/005/008/005/024
E140/E555

Emissivity of Thin Barium Oxide Films on Metal Bases

evaporation of active material, since variation of work function with thickness occurs monotonically. It is necessary to suppose the existence of at least two elementary processes. The curves obtained suggest the usual activation characteristic of an oxide cathode. It is therefore supposed that at temperatures of the order of 1200-1400°K, free barium appears in the systems studied. An inverse relationship is found between the thickness of optimal coating and activation temperature. However, the Richardson work function is independent of initial film thickness. It is proposed that increase of emission is not connected with decrease of work function but with variation of the area of the emitting centres, directly related to coating thickness at low thicknesses. It is supposed that the variations observed are connected with changes of state of the film material. The data obtained also are consistent with the concept of migration of particles over the surface during heat-treatment. Acknowledgments are made to the graduate student V. I. Zarudnyy for his assistance. There are 6 figures, 2 tables and 8 references: 6 Soviet and 2 non-Soviet

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ACCESSION NR: AT4016308 S/0000/62/000/000/0263/0283

AUTHOR: Shul'man, A. R.; Fridrikhov, S. A.

TITLE: Interaction of electrons with alkali halide crystals

SOURCE: Vses. soveshch. po fiz. shchelochnogaloidn. kristallov. 2d, Riga, 1961. Trudy*. Fiz. shchelochnogaloidn. kristallov (Physics of alkali halide crystals). Riga, 1962, 263-283

TOPIC TAGS: alkali halide crystal, dielectric, dielectric surface, elastic electron reflection, crystallography, radiation defect, electron irradiation, crystal physical property

ABSTRACT: For the last seven years, systematic studies of the electron bombardment of alkali halide crystals have been conducted in the Electronics laboratory of the Leningradskiy politekhnicheskiy institut (Leningrad Politechnical Institute). They covered elastic reflection of slow electrons, nonelastic electron reflection, characteristic electron energy losses, secondary electron emission, excited conductivity of NaCl-films, and the behavior of colored crystals. To reduce the charge accumulation on the dielectric surface and the changes in the target composition and structure, the bombardment was effected by an electron beam emitted in the form of a single rectangular 1-10μ sec pulse. An EPP-09 electron

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ACCESSION NR: AT4016308

potentiometer was used for the 1 min. tape-recordings. A drawing in the article shows the assembly in detail. Most of the results of the studies were of an exploratory nature and may be partially summarized as follows: (1) dielectrics, in contrast to metals, have a relatively high coefficient of slow electron elastic reflection, reaching a maximum of 70-80% for primary electron energies of a few ev; (2) energy spectra of electrons reflected from alkali halide crystals show two different patterns; full and discrete; (3) the threshold of second electron emission is a definition which casts some light on the energy zonal structure of alkali halide crystals; (4) the coefficient of second electron emission of the crystals is high and depends mainly on the energy of primary electrons; (5) a beam of slow electrons is a very sensitive indicator of color centers in the subsurface layer; and (6) the lower the lattice energy the greater the electron absorption; hence, the lower the depth of color penetration in the crystals. The authors make extensive use of references in their discussion of the subject. Orig. art. has: 15 figures and 3 tables.

ASSOCIATION: Leningradskiy politekhicheskiy institut im. M. I. Kalinina (Leningrad Polytechnical Institute)

ACCESSION NR: AT4016308

SUBMITTED: 00 DATE ACQ: 06Mar64 ENCL: 00

SUB CODE: GP NO REF SOV: 023 OTHER: 016

Card 3/3

S/181/62/004/003/028/045
B117/B108

AUTHORS: Shul'man, A. R., and Ganichev, D. A.

TITLE: Secondary electron emission and elastic reflection of slow electrons from different faces of a tungsten single crystal

PERIODICAL: Fizika tverdogo tela, v. 4, no. 3, 1962, 745 - 754

TEXT: The coefficients of secondary electron emission σ, of elastic reflection R, and of emission of slow electrons δ as functions of primary electron energy E_p were studied on the two faces (110) and (112) of a tungsten single crystal with different packings of atoms. The dependence of the coefficients on the primary electron angle of incidence was investigated. All measurements were made with hot targets (1300-1500°K) at a vacuum of $\sim 10^{-9}$ mm Hg. Results: The absolute values of the work function for the face (110) is 5.3 for the face (112) is 4.9, and for polycrystalline samples is 4.6 ev. These values agree with published data B. G. Smirnov and G. N. Shuppe. ZhTF, 22, 973, 1952). The curves $\sigma = f(E_p)$ showed a very complex character which was chiefly caused by the change of R with increasing E_p.

In the range of electron energies below 4 ev, an abnormal increase in R was observed with increasing E_p, and a tendency of R to decrease with higher E_p. At E_p = 4 ev, the curve $R = f(E_p)$ showed a distinct maximum which cannot be the consequence of ordinary electron diffraction on the crystal lattice. At small E_p, R depends on the crystallographic direction of the crystal face. The closely packed (110) faces have a higher R value than the (112). faces. δ increases monotonically with E_p and is nearly independent of the face structure. Position and width of the maxima corresponding to slow secondary electrons depend for small E_p on the energy of the primary electrons. With E_p of the order of 15-20 ev, the energy distribution of slow secondary electrons becomes independent of E_p. An angular dependence of δ and R was observed in the same energy range (15-20 ev). Measurements in this direction are being continued on molecularly smooth surfaces since the results obtained might be a consequence of the roughness of the surfaces. The authors thank G. N. Shuppe for supplying the single crystals. There are 10 figures and 17 references: 11 Soviet and 6 non-Soviet. The

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four most recent references to English-language publications read as follows: L. A. MacColl. Bell. Syst. Techn. J., 30, 888, 1951; H. A. Pauler and H. E. Farnsworth, Phys. Rev., 111, 1, 1958; H. P. Myers, Proc. Roy. Soc., A215, 329, 1952. O. Richardson a. J. Gimpl. Proc. Roy. Soc. A182, 17, 1943.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina
(Leningrad Polytechnic Institute imeni M. I. Kalinin)

PRESENTED: August 5, 1961 (initially)

SUBMITTED: November 22, 1961 (after revision)

40899
S/181/62/004/009/039/045
B104/B186

24.7000,
24.7100

AUTHORS: Kirsanova, T. S., Shul'man, A. R., and Dement'yeva, A. V.

TITLE: Work function of thin barium oxide films applied to heated tungsten

PERIODICAL: Fizika tverdogo tela, v. 4, no. 9, 1962, 2615-2617

TEXT: The change in the work function of a BaO-W system was determined as a function of the temperature of the W band during the spray coating of BaO. At pressures of the residual gas of $(1-2)\cdot 10^{-9}$ mm Hg, BaO was sprayed onto bands of temperatures between 800 and 1500°K. The dependence of the work function φ on the coating time t was determined for various temperatures of the W bands (Fig.). After some hours of spraying, φ becomes virtually independent of the coating time (equilibrium). If such a film is annealed for some hours at the temperature of the W-band during the coating, a quasistationary state is obtained in which the work function of the system does not noticeably change even on further heating. Annealing of the W-band during the spraying yields much more active thermionic emitters and more solid films than spraying onto cold bands. There is 1 figure.

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40900

S/181/62/004/009/040/045
B104/B186

24.7400
24.1640

AUTHORS: Kirsanova, T. S., Shul'man, A. R., and Gerasimova, A. P.

TITLE: Adsorption of barium oxide on the (110) face of a tungsten single crystal

PERIODICAL: Fizika tverdogo tela, v. 4, no. 9, 1962, 2617-2620

TEXT: The experiments were made with a method developed earlier (T. S. Kirsanova, I. Ye. Sakharov, Radiotekhn. i elektron., 5, 69, 1960). The (110) face of a tungsten single crystal was prepared at the Laboratoriya kafedry elektrofiziki Tashkentskogo gosudarstvennogo universiteta (Laboratory of the Department of Electrophysics of Tashkent State University). The experimental arrangement permitted heat treatment of the single crystal at temperatures up to 2600°K and simultaneous bombardment with electrons. The barium oxide was applied at a constant spraying rate of 0.015 monolayers/minute. The dependence of the work function on the temperature of the single crystal during the spraying was determined (Fig.). Results: When BaO is sprayed onto hot W backings, the adsorptive and thermionic properties of the BaO-W system depend

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Adsorption of barium oxide on...

considerably on the crystallographic orientation of the faces. Unlike in the adsorption of BaO on polycrystalline backings or on not densely packed tungsten atoms (T. S. Kirsanova et al., FTT, v. 4, no. 9, 1962, p. 2617; Radiotekhnika i elektron., 5, 840, 1960) the work function in the interval between room temperature and 1150°K does not decrease when BaO is adsorbed on densely packed W atoms. This is explained by the single-phase adsorption of barium oxide on the densely-packed tungsten surface atoms. There is 1 figure.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina
(Leningrad Polytechnic Institute imeni M. I. Kalinin)

SUBMITTED: May 24, 1962

Fig. Work function versus coating time t (minutes) at various temperatures of the W single crystal.
Legend: (1) 500°K; (2) 650°K; (3) 750°K; (4) 870°K; (5) 900°K; (6) 1150°K (annealing temperatures). Backing temperatures: (7) 300°K; (8) 650°K; (9) 750°K; (10) 870°K; (11) 900°K; (12) 1000°K; (13) 1150°K.

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5

NEMCHENOK, R.L.; SHUL'MAN, A.R.

Photoelectric and optical properties of a gold-barium system.
Radiotekh. i elektron. 7 no.9:1619-1625 S '62. (MIRA 15:9)
(Gold) (Barium) (Cathodes)

S/181/63/005/003/020/046
B102/B180

AUTHORS: Shul'man, A. R., Morozov, Yu. A., and Petrov, I. N.

TITLE: Secondary electron emission from tungsten, tantalum and yttrium oxide in the presence of a thermoemission current

PERIODICAL: Fizika tverdogo tela, v. 5, no. 3, 1963, 839-842

TEXT: To find the reason for the great differences observed in the temperature dependences of the secondary electron emission (coefficient σ), the authors determined the dependence of σ on the primary electron energy (V_p) the target temperature (T) and the pulse durations (t) of the primary current pulses, using the method described in ZhTF, 22, 1342, 1952. t was varied from 2 to 200 μsec, V_p from 100 to 2200 ev and all measurements were made in vacuo ($5 \cdot 10^{-9}$ mm Hg). The targets were annealed at 2200°C (W) 1800-1850 (Ta) and 1500-1550°C (YO). It was found that, despite the presence of thermoemission currents of up to the 10^4 times greater than the electron-emission current, σ was temperature-

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Secondary electron emission from ...

independent for W up to 2200°K, and up to 2100°K for Ta. For yttrium oxide σ fell slightly with temperature rising from 300 to 1500°K. The shape of the secondary current pulses remained constant for all samples, independent of t. By comparison with the results obtained for barium oxide, it is concluded that neither the presence of a thermoemission current nor a high temperature are sufficient or even necessary conditions for distortion of the secondary current pulse or for increase in σ with T. The anomalies observed at oxide cathodes must therefore be related to specific properties of the emitters. There are 3 figures.

ASSOCIATION: Leningradskiy politekhnicheskiy institut im. M. I. Kalinina (Leningrad Polytechnic Institute imeni M. I. Kalinin)

SUBMITTED: May 11, 1962 (initially)
October 8, 1962 (after revision)

Card 2/2